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Annual Scientific Meeting

Neuroradiology Head and Neck XVIII

Neuroimaging in Neuro-infection, from Intracranial, Head and Neck to Spine

February 26-27, 2022

e-Proceeding Annual Scientific Meeting

Neuroradiology Head & Neck XVIII

Panitia Annual Scientif Meeting Neuroradiology Head & Neck XVIII

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Editor:

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ANNUAL SCIENTIFIC MEETING NEURORADIOLOGY HEAD & NECK XVIII

FEBRUARY 26-27, 2022

Saturday, February 26, 2022

OPENING CEREMONY AND OPENING SPEECH		
08.00 – 08.25	Opening speech by MC Opening Ceremony	
08.25 – 08.30	Opening speech by Chairman of Committee	dr. Irene Indriana, Sp.Rad (K)N-KL, M.Kes
08.30 – 08.40	Opening speech by Chairman of PSNKLI	dr. Farhan Anwary, Sp.Rad (K) N-KL, MHKes
08.40 – 08.50	Opening speech by Chairman of PDSRKI	Letjen TNI (Purn) Dr. dr. Terawan Agus Putranto, Sp.Rad (K) RI
08.50 – 09.00	Opening speech by Chairman of IDI Lampung	Prof. Dr. dr. Asep Sukohar, M.Kes
Moderator : dr. Sri Andreani Utomo, Sp.Rad (K) N-KL		
MEDICAL ETHICS		
09.00 – 09.20	Doctor's anticipation in dealing with lawsuit	dr. Farhan Anwary, Sp.Rad (K) N-KL, MHKes
SCIENTIFIC SESSION I		
09.20 – 09.50	Neuroimaging in brain infection	dr. Farhan Anwary, Sp.Rad (K) N-KL, MHKes
09.50 – 10.05	Sponsor presentation	PT. Fujifilm
10.05 – 11.05	Neuroimaging of CNS infection	Prof. Kei Yamada, MD, PhD, FISMRM
11.05 – 11.35	How to differentiate brain infection with other lesion	dr. Melita, Sp.Rad (K) N-KL
11.35 – 11.55	Discussion	
SCIENTIFIC SESSION II		
Moderator : Prof. dr. Arif Faisal, Sp.Rad (K) N-KL, DHSM		
12.30 – 13.00	Covid 19 and meningitis: What should radiologist be aware	Prof. DR. dr. Yuyun Yueniwati, Sp.Rad (K) N-KL, M.Kes
13.00 – 13.30	Imaging on HIV/AIDS brain manifestation	dr. Sukma Imawati, Sp.Rad (K) N-KL
13.30 – 13.45	Sponsor presentation	PT. Philips
13.45– 14.15	The role of imaging in differentiating cervical lymphadenitis with tumors	Dr. dr. Anggraini Dwi Sensusiati, Sp.Rad (K) N-KL
14.15 – 14.45	Orbital infection, multimodality neuroimaging	dr. Sri Andreani Utomo, Sp.Rad (K) N-KL
14.45 – 15.05	Discussion	

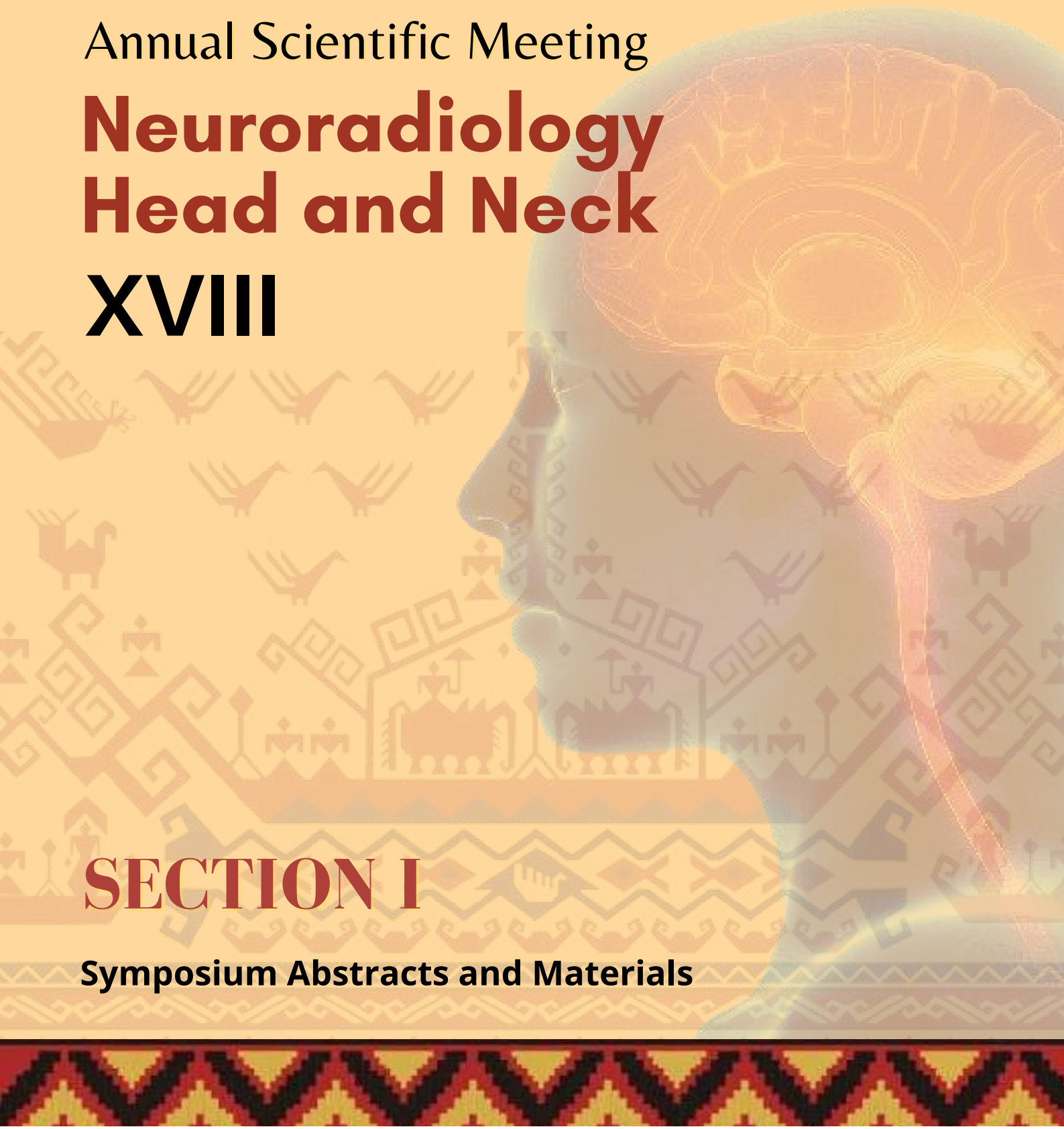
Sunday, February 27, 2022

SCIENTIFIC SESSION I		
Moderator : dr. Melita, Sp.Rad (K) N-KL		
08.00 – 09.00	Introduction to neuroimaging of CNS infections: a pattern recognition approach	Prof. Paul M. Parizel, MD, PhD, FRANZCR
09.00 – 09.10	Sponsor presentation	PT. Siemens
09.10 – 09.40 :	CNS tuberculosis: Pathophysiology and imaging finding	dr. Tan Siauw Koan, Sp.Rad (K) N-KL, M.Sc
09.40 – 10.10	Imaging in spine and spinal cord tuberculosis	Prof. dr. Arif Faisal, Sp.Rad (K) N-KL, DHSM
10.10 – 10.40	Neuroimaging of the spine: Infection or an imitation	dr. Made Widhi Asih, Sp.Rad (K) N-KL
10.40 – 11.00	Discussion	
SCIENTIFIC SESSION II		
Moderator : Dr. dr. Anggraini Dwi Sensusiati, Sp.Rad (K) N-KL		
12.30 – 13.00	Transcranial ultrasound: What to know and what to do	Prof. DR. dr. Yuyun Yueniwati, Sp.Rad (K) N-KL, M.Kes
13.00 – 13.15	Sponsor presentation	PT. GE
13.15 – 13.45	The role of transcranial doppler in the evaluation of acute meningitis	dr. Dwijaputra Ayusta, Sp.Rad (K)N-KL
13.45 – 14.15	Imaging in paranasal sinuses	Dr. dr. Widiana Ferriastuti, Sp.Rad (K) N-KL
14.15 – 14.45	Middle ear and mastoid infection imaging	dr. Junus Asiu Bulu Baan, Sp.Rad (K) N-KL
14.45 – 15.05	Discussion	
15.05 – 15.15	Announcement of scientific competititon winners	
15.15 – 15.25	Closing ceremony	

Annual Scientific Meeting

Neuroradiology Head and Neck

XVIII



SECTION I

Symposium Abstracts and Materials

Neuroimaging of CNS infection

Kei Yamada MD, PhD

Infections of the central nervous system (CNS) can be potentially life-threatening and neuroimaging plays crucial role in evaluating these patients. CNS infection can be classified in multiple different ways, for example, it can be classified based on locations, organisms, and route of transmissions [1,2]. In this lecture, I will try demonstrating most of these categories using the real-life cases that I have experienced.

When evaluating these patients, CT would be the first-line technique that is most available. However, MRI has far superior contrast, and thus it would be the modality of choice, especially when initial CT scan turns out to be negative. When performing MRI, proper choice of imaging sequences will be of vast importance. Diffusion-weighted imaging (DWI) should be always included in the protocol, as it will highlight the abscesses as bright objects. If possible, the fractional anisotropy (FA) maps of DWI could be potentially useful [2,3].

FLAIR will be another sequence to be included and it would be especially useful after contrast administration, which will highlight the lesions adjacent to the cerebrospinal fluid (CSF) [3]. It is thus useful when meningitis is clinically suspected.

This lecture will be divided up into three different parts. I will first cover the basics of imaging methods. Then I will present a few brain cases. In the third (last) part, I will present a few spinal cases. I will present them as if they are the cases being discussed in the real-life conferences held within the hospitals, so active participation of the audiences will be encouraged.

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Covid-19 and Meningitis: What Should Radiologist be Aware

Yuyun Yueniwati

Radiology department, Faculty of Medicine, Universitas Brawijaya Malang

ABSTRACT

Many reports suggest the SARS-CoV-2 infection may result in neurological complications. A widespectrum of clinical syndromes have been reported, including both central and peripheral nervoussystem. Such symptoms may be a consequence of a direct viral injury, secondary to systemic inflammatory response, autoimmune processes, ischemic lesions or combination of these. Anosmia and dysgeusia are highly prevalent in the early stage of infection. Cerebrovascular eventsin patients with COVID-19 have also been documented with increasing frequency. Some cases ofPara infectious autoimmune neurologic manifestations concurrent with active SARS-CoV-2infection have been described, including haemorrhagic necrotizing encephalopathy, Guillain- Barré and Miller-Fisher syndromes. There are also a few reports documenting encephalitis and acute demyelinating encephalomyelitis (ADEM) in the course of COVID-19. Many of these neurological manifestations of the infection are possible to distinguish using radiological imagingtechniques. It plays a very important role in evaluating the course of COVID-19 as well as diagnosing respiratory complications and choosing a proper management of infected patients. Similarly, radiological techniques play crucial role in identifying the cause of neurological symptoms connected to SARS-CoV-2 infection, being one of the most important elements of diagnostics.. In this review, we present the most important neurological complications that may occur in the course of SARS-CoV-2 infection and summarize their radiological manifestations.

INTRODUCTION

First reported in Wuhan, China, COVID-19 predominantly presents with respiratory symptoms and fever. However, it is known to have several atypical manifestations.

Many reports suggest that the infection may result in neurological complications. A wide spectrum of clinical syndromes has been reported, including both central and peripheral nervous system.

Such symptoms may be a consequence of a direct viral injury, secondary to systemic inflammatory response, autoimmune processes, ischemic lesions, or combination of these (1, 2).

The largest study to date analysing 214 patients of Wuhan hospitals shows that neurological symptoms were present in 36.4% of cases, of which dizziness and headache were most prevalent (3).

Anosmia and dysgeusia are common in early stages of the disease and have been considered evidence of hypothetical olfactory tract invasion (4).

Another concerning fact is a correlation of COVID-19 to cerebrovascular events, such as stroke, that affects ~1–3% of hospitalized patients (5).

Moreover, autoimmune-based manifestations such as acute disseminated encephalomyelitis, haemorrhagic necrotizing encephalopathy (6), Guillain–Barré syndrome, and Miller– Fishersyndrome (MFS) have also been observed in patients with SARS-CoV-2 infection (2, 7).

Radiological imaging plays a crucial role in evaluating the course of COVID-19 as well as diagnosing respiratory complications and choosing a proper management of infected patients.

Similarly, radiological techniques play a crucial role in identifying the cause of neurological symptoms connected to SARS-CoV-2 infection, being one of the most important elements of diagnostics.

Magnetic resonance imaging (MRI) and computed tomography (CT) are the best radiological methods to visualize the effects of the infection on the nervous system.

In this review, we present the most important neurological complications that may occur in the course of SARS-CoV-2 infection and their radiological manifestations.

NEUROLOGICAL INVOLVEMENT IN THE COURSE OF COVID-19

It is well-documented that COVID-19 is as much of a respiratory disease as a neurological one.The mechanism of infection has been thoroughly explained and proved.

SARS-CoV-2 virions are equipped with a viral structural spike (S) protein that binds to the angiotensin-converting enzyme 2 (ACE2) receptor on human cells.

There is high expression of the ACE2 receptor in multiple organs, including lung epithelial cells, but also in heart, kidney, pancreas, spleen, gastrointestinal system, bladder, cornea, and blood vessels (8, 9).

The ACE2 receptor is also found in the central and peripheral nervous systems and in skeletal muscle (10, 11).

Viral replication within human host cells is followed by viral release through cell destruction (8, 9). Moreover, SARS-CoV-2 activates an inflammatory response that can result in a cytokine storm and ultimately multi-organ injury (8, 9).

However, the origins of neural involvement is not yet fully uncovered. There are a couple of presumable mechanisms of neural involvement during SARS-CoV-2 infection.

First of all, a known neurotropism of previous SARS- CoV strains is the basis of the direct central nervous system (CNS) spread theory. The virus could access the CNS through olfactory pathways or the bloodstream, causing meningitis and encephalitis (12, 13).

The involvement of the respiratory center in the brainstem can explain the well-documented rapid respiratory aggravation with marked hypoxia despite a lack of symptomatic dyspnea (14).

Another hypothesis is the indirect involvement of neurological tissue due to an excessive systemic inflammatory response. In this case, an uncontrolled immune reaction is the cause of widespread dysregulation of homeostasis with coagulopathy. It may also increase the risk of acute cerebrovascular diseases (CVDs) (15, 16).

Several autoimmune-based neurologic complications such as acute disseminated encephalomyelitis and Guillain–Barré syndromes, as known parainfectious syndromes, can also be considered as a straight outcome from a microbial infection (6, 17, 18).

Complications may concern both central and peripheral nervous system and occur with different frequencies. According to data from China, presence of various neurological symptoms reached 36.4% of hospitalized patients (19). Other data showed that occurrence of such complications reached even more than 60% patients.

Symptoms from the nervous system may appear during the acute phase or the subacute phase or even show up in the later stages of the infection. Moreover, they may even precede the symptoms from the respiratory system.

Anosmia and dysgeusia are highly prevalent in the early stage of infection (20). It has been proposed as a support of the hypothesis of CNS spread *via* the olfactory tract (21).

Cerebrovascular events in patients with COVID-19 have also been documented with increasing frequency (22, 23).

Some cases of parainfectious autoimmune neurologic manifestations concurrent with active SARS-CoV-2 infection have been described, including hemorrhagic necrotizing encephalopathy (6), Guillain–Barré syndrome, and MFS (6, 17, 18, 24, 25).

There are also a few reports documenting encephalitis and acute demyelinating encephalomyelitis (ADEM) in the course of COVID-19.

There is also a growing number of cases of patients after recovery from COVID-19 with memory dysfunction, cognitive functions disorders, depression, or other affective disorders, which may lead to a decrease of intellectual functions.

Many neurological manifestations of the infection mentioned above are possible to distinguish using radiological imaging.

MANIFESTATION OF CENTRAL NERVOUS SYSTEM COMPLICATIONS IN RADIOLOGICAL FINDINGS

Meningoencephalitis, Encephalopathy, and Disruptions of Consciousness

Encephalitis, meningitis, and encephalopathy were reported as complications in COVID-19patients. However, only several cases of such complications have only been documented.

The frequency of encephalitis presented in two retrospective studies was 0.03% (32) and 0.1%(26).

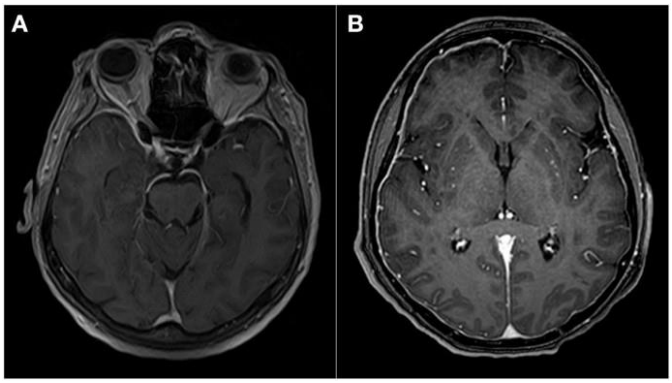

Figure 1 | T1 contrast-enhanced images **(A,B)** show pachymeningeal enhancement in two different patients, indicative of meningitis. In case **(A)**, it was an isolated finding, while in case **(B)**, coexisting white matter lesions suggestive of acute demyelination were present.

A couple of retrospective studies reported seizures with the frequency ranging from 0.5 to 1.4% (19, 34). Cases of all types of seizures were reported in patients with COVID-19.

Meningitis can be observed in MRI examination. In T1 images, the presentation may be normal; however, sulci may appear less hypointense than normal. After applying gadolinium contrast, a pachymeningeal enhancement can be observed.

In **Figure 1**, we present a manifestation of meningitis in MRI of a patient with an ongoing SARS-CoV-2 infection

Acute Disseminated Encephalomyelitis (ADEM)

It is a rare acute inflammation and demyelination of white matter that typically follows a recentviral infection or vaccination. Usually, gray matter is also involved, especially basal ganglia, but to a lesser extent than white matter. Similarly, the spinal cord can also be affected.

There are only a few documented cases of ADEM in the course of COVID-19 (27, 28).

In MRI, ADEM is observed In T2 images as regions of high signal, with surrounding edema typically situated in subcortical locations. The thalami and brainstem can also be involved.

After administering gadolinium contrast medium, a punctate, ring, or arc enhancement is oftendemonstrated along the leading edge of inflammation in T1 C+ images.

In **Figure 2**, we present a series of images from MRI from the single patient with ADEM in thecourse of COVID-19 who was treated in the Department of Neurology of our hospital.

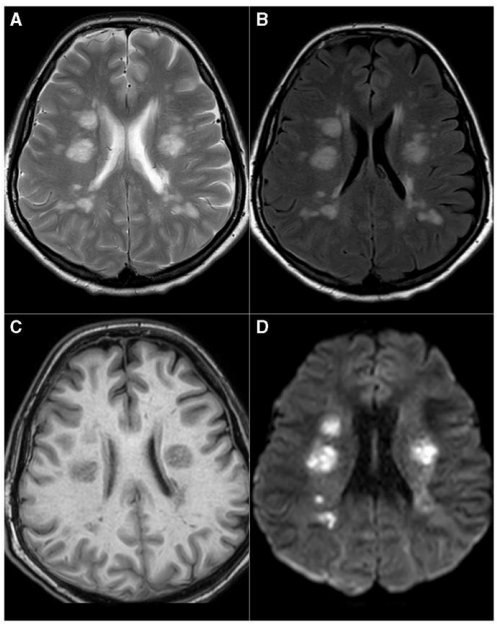

Figure 2 | Acute disseminated encephalomyelitis (ADEM). Multiple, bilateral T2 **(A)** and FLAIR **(B)** hyperintense foci present in periventricular areas of white matter, hypointense, or invisible on T1-weighted images **(C)**. These lesions show pronounced diffusion restriction seen ashigh-signal intensity on DWI images **(D)**.

SUMMARY

As the COVID-19 pandemic has been advancing, a growing number of complications from multiple systems are being observed. There is a general consensus that this disease is not a respiratory illness, but a systematic one.

As we presented in this article, a vast number of neurological symptoms can emerge from this viralinfection and still not all complications involving nervous system are fully discovered.

As symptoms from the nervous system may precede the symptoms from the respiratory system, appear in the acute or subacute phase of the disease, or show up in the later stages of the infectionor even months after recovery, it is crucial to take care of such patients holistically and precisely monitor them during the control visits.

Especially in case of the presence of nervous system implication, using radiological imaging techniques to monitor the emerging onset of various symptoms is crucial to assess the severity andscope of involvement.

The growing number of new SARS-CoV-2 infection all over the world statistically indicates that the number of neurological complications and reports of such manifestations will be growing accordingly.

Therefore, it is so important to collect feedback and identify as many cases as possible in order toallow early recognition and faster diagnosis.

Although there are not many radiological signs of neurological complications specific to COVID-19, the presence of group of symptoms may be crucial to distinguish particular syndromes and implement the proper treatment.

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Temuan Radiologi Infeksi HIV/AIDS pada Otak

Sukma Imawati

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PENDAHULUAN

Human immunodeficiency virus (HIV) adalah retrovirus manusia yang menyebabkan Acquired Immunodeficiency Syndrome (AIDS). Ada dua subtipe, HIV-1 dan HIV-2. HIV telah menginfeksi sekitar 65 juta orang, menyebabkan 25 juta kematian sejak wabah penyakit pada tahun 1981. Diperkirakan 38,6 juta orang terinfeksi HIV, dan hampir 3 juta orang meninggal karena AIDS pada tahun 2005. Pengenalan terapi antiretroviral (ART) yang sangat aktif menurunkan kejadian AIDS secara keseluruhan dan secara substansial meningkatkan kelangsungan hidup setelah diagnosis AIDS.[1]

HIV adalah organisme neurotrofik yang memasuki susunan syaraf pusat segera setelah pajanan. HIV menyebabkan cedera saraf yang menyebabkan gangguan kognitif. Manifestasi neurologis dari infeksi HIV seperti infeksi oportunistik maupun neoplasma, termasuk encephalopathy, myelopathy, perifer neuropati, dan myelopathy. Perubahan inflamasi biasanya terjadi di daerah subkortikal, deep white matter dan grey matter seperti ganglia basal serta thalamus. Disfungsi neurologis tidak hanya berhubungan langsung dengan infeksi neuron, tetapi gabungan berbagai faktor seperti aktivasi sel imunokompeten dan toksin.[1]

TEMUAN RADIOLOGIS

A. HIV encephalopathy

HIV encephalopathy (HIVE) merupakan penyebab tersering kelainan neurologis pasien AIDS akibat langsung infeksi HIV pada susunan syaraf pusat (SSP). HIVE mempunyai gejala demensia progresif yang ditandai dengan gangguan kognitif dan gejala motorik seperti gait dan tremor. Secara kolektif, sindrom klinis ini dikenal sebagai AIDS dementia complex. Temuan imajing terlihat subacute encephalitis, cerebral atrophy, dan demyelinasi. Perkembangan penyakit tampak gambaran klasik berupa confluent, bilateral dan symmetrical white matter lesions berupa white matter change regio periventricular dan centrum semiovale, tanpa keterlibatan subcortical white matter dan struktur fossa posterior. CT scan tampak sebagai lesi hipodens. MRI lebih sensitive berupa lesi hiperintens di T2WI dan isointense di T1WI. Tak tampak enhancement post injeksi kontras maupun efek massa.[2]

Temuan lain dari HIVE berupa patchy hyperintensity pada basal ganglia dan white matter (sibtain). Modalitas neuroimaging canggih, seperti MR Spektroskopi, Diffusion Tensor Imaging, Arterial Spin Labelling dapat digunakan pada kasus HIVE untuk pemantauan respon terapi.[3]

B. Diffuse Cytomegalovirus Encephalitis

Cytomegalovirus (CMV) adalah subtipe virus herpes yang tetap laten pada kebanyakan orang dewasa dan dapat aktif kembali dengan AIDS. Temuan klinis dan pencitraan yang mirip dengan HIVE. Pasien dengan CMV biasanya memiliki durasi AIDS yang lebih lama, dengan jumlah CD-4 yang lebih rendah (kurang dari 200 cell/mm), dan memiliki demensia yang berkembang lebih cepat dibandingkan HIVE. Karakteristik MRI

pada diffuse CMV encephalitis berupa diffuse hiperintens signal T2WI pada white matter tanpa enhancement dan efek massa. CT scan tampak normal atau hanya menunjukan atrofi.[2]

C. Progressive multifocal leukoencephalopathy

Progressive multifocal leukoencephalopathy (PML) merupakan penyakit progresif SSP akibat AIDS yang disebabkan oleh JC papopavirus. Sekitar 80% populasi memiliki fase laten infeksi, dan reaktivasi virus terjadi ketika imunitas terganggu. Gambaran imajing berupa patchy areas dengan intensitas signal hipointens di T1WI, hiperintens di T2WI pada subcortical white matter. Lesi sering bilateral dan asimetris. Lesi tidak memberikan efek massa. Permukaan tampak scalloping dengan keterlibatan *arcuatus fiber*. Lokasi tersering di daerah parietal, jarang di fossa posterior, basal ganglia, dan thalamus. Penting membedakan HIVE dengan PML berkaitan dengan prognosis dari keduanya. MR spectroscopy HIVE menunjukan peningkatan myoinositol, peningkatan choline dan penurunan NAA. PML menunjukan peningkatan signifikan Choline dengan variasi level myoinositol dibandingkan HIVE. Temuan yang lebih substansial adalah bahwa penurunan tingkat NAA terjadi lebih awal pada HIVE sebelum kelainan MRI konvensional terjadi, menunjukkan bahwa MRS dapat digunakan untuk deteksi dini kerusakan otak akibat HIV.[2]

D. Herpes viral encephalitides

Virus herpes simpleks menghasilkan ensefalitis nekrotikans yang pada immunocompromise terlihat lebih diffuse dibandingkan tipe klasik berupa lesi pada lobus temporal medial dan frontal inferior. Varicella-zoster virus (VZV) juga menyebabkan multifokal encephalitis pada white matter yang post injeksi kontras tampak rim enhance.[2]

E. Toxoplasmosis

Toksoplasmosis adalah infeksi SSP yang paling sering pada populasi AIDS, terjadi pada jumlah CD-4 di bawah 100/mm^3. Hal ini disebabkan oleh protozoa obligat intraseluler Toxoplasma gondii dan menyebabkan infeksi pada pasien imunokompeten dan reaktivasi pada pasien dengan gangguan sistem imun. Pada CT dan MRI ditemukan multile lesi enhance dengan perifocal edema dan efek massa pada basal ganglia dan white-grey matter interface hemisfer serebri, namun bisa juga mengenai semua lokasi dari otak. CT scan tanpa kontras tampak lesi hipodens atau isodens yang post pemberian kontras tampak ring atau solid enhancement. MRI lebih sensitive dibandingkan CT scan. Lesi terlihat hipointens di T1WI, isointense atau hipointens di T2WI dibandingkan parenkim otak dengan perifocal edema atau bisa juga ditemukan lesi sentral hiperitens dengan tepi isointense.[2]

Kepustaan lain menyebutkan karakteristik temuan CNS Toxoplasmosis berupa multiple lesi diameter 2-3cm dengan ring contrast enhancement dan perifocal edema, namun bisa juga ditemukan lesi soliter pada 15-20% kasus. Lokasi tersering pada basal ganglia, thalamus, subcortical white matter, dan cerebellum. Kontras enhancement kadang tidak ditemukan jika kadar serum CD4-positive T lymphocyte < 50 cells/mm^3. Tanda patognomonik untuk CNS toxoplasmosis adalah target sign pada T2WI dan eccentric target sign pada T1WI dengan kontras. Consentric target sign T2WI ditandai berupa area hipointens-hiperintens konsentris. Eccentric target sign berupa lesi ring enhance disertai contrast-enhanced eccentric nodule. Cincin tersebut sesuai dengan zona vaskular inflamasi di tepi lesi nekrotik, dan nodul sesuai dengan sekelompok pembuluh darah yang menebal.[3]

F. Lymphoma

Primary Central Nerve System lymphoma (PCNSL) merupakan penyebab paling umum kedua dari massa intrakranial setelah toksoplasmosis, terjadi pada hingga 6% dari semua pasien AIDS. Secara histologis merupakan tipe sel B non-Hodgkin dan memiliki tingkat mitosis yang tinggi: volume tumor dapat berlipat ganda

dalam waktu kurang dari 14 hari. Ekspresi virus Epstein-Barr (EBV) hadir di sebagian besar tumor, menunjukkan bahwa virus ini terlibat dalam tumorigenesis. PCNSL biasanya merupakan massa hiperdens soliter pada CT, yang mencerminkan kepadatan selulernya yang tinggi. Lesi multifokal terlihat pada 50%. Pada MRI, tampak lesi hipointens atau isointens pada T1WI dan T2WI, dengan sentral hiperintens akibat nekrosis pada T2WI. Pola enhancement bervariasi bisa homogen, heterogen atau cincin. Perdarahan atau kalsifikasi jarang dijumpai. Lokasi tersering di white matter periventrikular, ganglia basal, corpus callosum dan thalamus. Penyebaran tumor periventrikular yang menyebabkan encasement ventrikel sering ditemukan. Lokasi PCNSL yang tidak umum lebih sering terjadi pada pasien AIDS daripada pasien non-AIDS, yaitu di batang otak, saraf kranial, kelenjar pineal dan sinus kavernosa.[2]

Beberapa teknik MRI tambahan seperti Diffusion Weighted Imaged (DWI), MR Spektroskopi, MR perfusi berguna membedakan PCNSL terkait HIV dari CNS-Toxo, pada PCNSL ditemukan nilai Apparent Diffusion Coefficient (ADC) lebih rendah, nilai rasio Choline/Creatine lebih tinggi dan nilai relative Cerebral Blood Flow (rCBF) lebih tinggi. Namun, temuan ini harus difikirkan lebih hati-hati terutama heterogenitas jaringan intralesi akibat nekrosis dan perdarahan.[3]

G. Cryptococcomas

Cryptococcus neoformans adalah organisme menular ketiga yang paling umum yang melibatkan SSP, terjadi pada 5% pasien AIDS. Jamur masuk melalui inhalasi dan menyebar secara hematogen ke SSP, awalnya mengenai CSF dan meningen selanjutnya membentuk pseudocyst gelatinous yang memproduksi mucoid di dalam ruang perivascular virchow–robin. Jika terus berkembang biak akan mengganggu sawar darah-otak dan membentuk kumpulan sel dan organisme inflamasi intraparenkim, yang disebut crytococcoma.[2]

Meningoencephalitis sebagai lesi awal akan terlihat berupa penebalan dan enhancement sisterna basalis. Pseudocyst gelatinous akan terlihat gambran soap bubble appearance di MRI dengan intensitas signal hipo-isointens di T1WI, hiperintens di T2WI, hipointens di FLAIR. Lokasi dari gelatinous pseudocyst ditemukan di basal ganglia, thalamus dan midbrain.[3] Crytococcoma terlihat sebagai lesi solid atau ring enhance intraparenkim yang dikelilingi oleh edema. Lokasi sesuai dengan perivascular space, etapi bisa mengenai plexus choroid dan menyebabkan hydrocephalus obstructive.[2]

H. Infeksi Mycobacterial

Tuberkulosis (TB) dapat terjadi pada tahap awal penyakit HIV. Keterlibatan SSP terlihat pada 10% dari semua pasien dengan TB terkait AIDS dibandingkan dengan 2-5% dari semua pasien hanya TB. Reaktivasi penyakit laten merupakan mekanisme utama.[2]

Pada pasien dengan CNS-TB dengan meningitis, temuan neuroimaging klasik termasuk hidrosefalus (75%), eksudat basilar (38%), infark periventrikular (15-30%), dan tuberkuloma parenkim otak (5-10%), yang mungkin terlihat secara terpisah atau bersamaan. Peradangan juga dapat melibatkan pembuluh darah yang mengakibatkan gangguan sirkulasi dan vasospasme, dengan komplikasi infark, yang sering bilateral di basal ganglia.[3]

Tuberkuloma intraparenkim (granuloma tuberkulosis) terlihat sebagai lesi multipel kurang dari 1 cm pada white-grey matter interface dan periventricular. Efek massa dan edema minimal. CT scan kadang temukan ring-enhancing lesion. Target sign walaupun bukan tanda pathognomic dapat terlihat sebagai kalsifikasi sentral atau enhancement puntata yang dikelilingi area hipodens dengan rim enhancement. Pada T1WI lesi tampak isointense terhadap grey matter dan memiliki tepi hiperintens. Pada T2WI temuan sesuai dengan fase evolusi dari granuloma. Non caseating granuloma fase awal tampak sebagai lesi hyperintense di T2WI dengan nodular enhancement. Granuloma caseating akan terlihat hypointense di T2w dengan rim enhancement, kadang juga ditemukan sentral hyperintense akibat likuifaksi nekrosis. Tuberkuloma fase lanjut akan tampak

kalsifikasi atau bahkan suatu area encephalomalacia. Abses tuberkulosa terlihat sebagian lesi besar, kadang soliter, loculated dengan efek massa dan edema, yang post injeksi kontras tampak rim enhancement tipis dan uniform.[2]

I. Cytomegalovirus

Cytomegalovirus (CMV) adalah virus herpes yang sangat umum yang tidak menimbulkan gejala klinis pada kebanyakan orang dengan sistem kekebalan yang kuat. Epidemiologi dan gambaran klinis CMV dalam bentuk laten pada populasi umum dan aktif kembali pada kekebalan menurun. Keterlibatan SSP biasanya berupa meningoensefalitis atau ventrikulitis, tetapi juga dapat berupa mielitis, poliradikulitis, dan retinitis. Pasien dengan retinitis CMV memiliki sepuluh kali lipat peningkatan risiko terkena ensefalitis CMV. CMV juga dapat menyebabkan polineuropati progresif. Diagnosis klinis infeksi CMV terjadi pada kurang dari 2% pasien AIDS dengan gangguan neurologis; namun, pada otopsi, bukti CMV ditemukan pada 10% -40% pasien. Infeksi CMV biasanya terjadi ketika jumlah CD-4 turun di bawah 50 sel/µL. Ensefalitis nodular mikroglial dan ventrikuloensefalitis adalah pola histopatologi yang paling umum. Temuan radiologi keterlibatan SSP pada pasien dengan infeksi CMV sering tidak spesifik, dan kadang temuan pencitraan CT dan MR adalah normal. Demielinasi dapat mengakibatkan abnormalitas white matter difus yang akan terlihat hipodens pada CT scan dan hiperintens pada T2WI. Pada meningoensefalitis atau ventrikulitis CMV akan terlihat area hipodens pada white matter dan ependymal enhancement pada CT scan, pada MRI akan terlihat area hiperintens di T2WI focal atau difus pada white matter, ependymal, subependymal, dan periventricular. Pada kasus yang jarang, CMV dapat bermanifestasi berupa ring enhancement lesions. Differential diagnosis CMV ventriculitis adalah bacterial ventriculitis dengan onset akut, lainnya lymphoma, namun lebih sering terlihat nodular-irregular ependymal enhancement.[4]

J. Neurosyphilis

Neurosifilis adalah penyakit menular seksual akibat infeksi spirochete Treponema pallidum. Epidemiologi dan temuan klinis Neurosifilis mempengaruhi sekitar 1,5% dari populasi AIDS. Keterlibatan SSP terjadi pada 5% -10% pasien yang tidak diobati dan dapat terjadi pada setiap tahap infeksi sifilis. Diagnosis sulit temukan karena banyak pasien dengan neurosifilis tidak menunjukkan gejala spesifik, kadang muncul gejala tidak spesifik seperti sakit kepala, kejang, perubahan kepribadian, dan kebingungan. Kasus simtomatik dapat dibagi menjadi empat jenis berdasarkan gambaran klinis yang dominan : meningeal, vaskular, paresis general, dan tabes dorsalis. Bentuk neurosifilis yang paling umum adalah meningeal dan vaskular, sedangkan paresis general dan tabes dorsalis jarang terjadi pada era antibiotik.[2]

Gejala yang terjadi pada bentuk meningeal mirip dengan meningitis akut: sakit kepala, neuritis kranial, dan hidrosefalus. Bentuk ini biasanya terjadi pada 2 tahun pertama infeksi. Sifilis vaskular biasanya terjadi 5-7 tahun setelah infeksi primer dan ditandai dengan sakit kepala, hemiparesis, dan temuan cairan serebrospinal yang abnormal. Pasien dapat mengalami leptomeningitis dan arteritis multifokal, kondisi tersebut berpotensi menyebabkan infark serebral, baik endarteritis pembuluh darah kecil maupun arteritis pembuluh darah besar dan sedang. Temuan lain termasuk nonspesifik white matter lesions dan gumma serebral. Gumma mewakili massa nekrosis yang dibatasi retikulin akibat infiltrasi meningen dan otak oleh limfosit dan sel plasma yang pada fase akhir digantikan oleh fibrosis dan nekrosis. Temuan radiologis neurosifilis beragam mulai atrofi ringan-sedang, lesi white matter, infark kortikal-subkortikal, gumma, enhancement leptomeningeal dan arteritis.[4]

K. Cerebrovasular disease

Beberapa faktor berkontribusi pada peningkatan frekuensi kejadian serebrovaskular pada pasien HIV. Infark dapat terjadi pada TB, meningitis kriptokokus atau neurosifilis. Pada meningitis TB, infark serebral terjadi dari

arteritis, vasospasme dan trombosis arteri perforasi kecil yang berasal dari dasar otak dan berjalan melalui eksudat leptomeningeal gelatinous. Neurosifilis menyebabkan vaskulitis pembuluh darah besar dan kecil, dan vaskulitis serebral juga terjadi pada infeksi toksoplasmosis, CMV, dan VZV.[2]

L. Immune Reconstitution Inflammatory Syndrome

ART berhasil menekan replikasi HIV dan meningkatkan kekebalan seluler, yang melindungi pasien terinfeksi HIV dari infeksi oportunistik, Namun, pada beberapa pasien, kekebalan spesifik pada fase pemulihan dapat memperburuk penyakit yang sudah ada sebelumnya; kondisi yang dihasilkan disebut sebagai immune reconstitution inflammatory syndrome (IRIS). IRIS terjadi pada bulan-bulan awal setelah onset ART. Temuan neuroimaging bervariasi, tergantung pada kondisi patologis yang mendasarinya, dan mungkin atipikal, seperti prominent, progressive enhancement dan efek massa seperti PML.[4]

Pada MRI ditemukan lesi hiperintens di T2WI dan FLAIR dengan efek massa, restricted diffusion pada tepi lesi dan enhance post injeksi kontras.[3]

KESIMPULAN

Temuan neuroimaging dari SSP pada infeksi HIV/AIDS bervariasi, seperti lesi massa, atrofi, demielinasi, komplikasi vaskular, dan meningoensefalitis. ART telah menyebabkan kemajuan temuan pencitraan, tetapi kadang-kadang dapat ditemukan IRIS yang memiliki temuan pencitraan atipikal.

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Peran Imejing dalam Membedakan Limfadenitis Dan Limfadenopati Malignant

Anggraini Dwi Sensusiati

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Abstrak

Pada praktik klinis, istilah limfadenitis dan limfadenopati lebih banyak diperlakukan sebagai sinonim, meskipun kedua kondisi ini berbeda. Pembesaran kelenjar getah bening merupakan gejala nonspesifik nodus yang sering menyulitkan dokter klinis maupu ahli radiologi. Kondisi ini paling sering disebabkan karena infeksi tetapi juga dapat dihubungkan dengan proses yang lebih agresif seperti malignan. Evaluasi klinis yang tepat sangat penting dalam penilaian pembesaran kelenjar getah bening. Untuk mengkonfirmasi bahwa penyebab dari kelainan pada kelenjar getah bening adalah infeksi maka tes darah, kultur darah, biopsy kelenjar getah bening, dan tes cairan kelenjar getah bening perlu dilakukan. Pemeriksaan dengan modalitas imejing dilakukan untuk mengevaluasi kelenjar getah bening yang tidak memiliki fitur klinis dengan penyebab jinak, mengkonfirmasi kelenjar getah bening sebagai penyebab kelainan teraba, dan mengevaluasi bagian kepala dan leher yang belum atau tidak bisa diperiksa.

PENDAHULUAN

Limfadenitis disebabkan oleh infeksi di kelenjar getah bening. Infeksi kelenjar getah bening umumnya merupakan infeksi sekunder dari infeksi virus, bakteri, atau jamur dibagian tubuh yang lain. Limfadenitis dapat menyebar dengan cepat ke kelenjar getah bening lain di seluruh tubuh, dan diperlukan pengobatan segera dengan menggunakan obat antibiotics, antivirals, atau antifungal (1).

Pada praktik klinis, istilah limfadenitis dan limfadenopati lebih banyak diperlakukan sebagai sinonim, meskipun kedua kondisi ini berbeda. Limfadenitis adalah infeksi kelenjar getah bening yang menunjukkan infeksi yang mendasarinya, sedangkan limfadenopati hanya menggambarkan pembesaran abnormal atau konsistensi kelenjar getah bening karena sejumlah alasan (2).

Kelenjar getah bening yang termasuk dalam kategori abnormal antara lain kelenjar supraklavikula, poplitea, dan iliaka teraba, dan kelenjar epitroklear lebih besar dari 5 mm (2). Kelenjar getah bening yang keras atau kusut mungkin menunjukkan keganasan atau infeksi.

1. Pemeriksaan Kelenjar Getah Bening

Pada limfadenitis, diagnosis umumnya dilakukan dengan berdasar pada gejala, pemeriksaan fisik, dan pemeriksaan penunjang lain. Untuk mengkonfirmasi bahwa penyebab dari kelainan pada kelenjar getah bening adalah infeksi maka tes darah, kultur darah, biopsy kelenjar getah bening, dan tes cairan kelenjar getah bening perlu dilakukan.

Pemeriksaan dengan modalitas imejing dilakukan untuk mengevaluasi kelenjar getah bening yang tidak memiliki fitur klinis dengan penyebab jinak, mengkonfirmasi kelenjar getah bening sebagai penyebab kelainan teraba, dan mengevaluasi bagian kepala dan leher yang belum atau tidak bisa diperiksa (termasuk area yang tidak dapat diperiksa secara klinis, seperti ruang yang ditentukan fasia dalam).

Ultrasonografi dapat digunakan untuk mengkonfirmasi kelenjar getah bening yang abnormal, mengkarakterisasi ukuran, bentuk, batas, arsitektur internal, vaskularisasi, dan jaringan lunak perinodal(3). Beberapa kelebihan penggunaan ultrasonografi dalam pemeriksaan kelenjar getah bening adalah rendahnya

radiasi pengion dan kemampuan ultrasonografi dalam mengkarakterisasi kelenjar getah bening sebagai kistik atau padat.

Baik CT maupun MRI dengan kontras dapat digunakan untuk mengkarakterisasi lebih jauh kelainan sonografi serta untuk mengkonfirmasi kelainan kelenjar yang lebih dalam, bila terdapat kecurigaan (4). Kelebihan CT dan MRI dengan kontras termasuk lokalisasi anatomi yang lebih superior, penentuan ukuran, jumlah, bentuk, batas, arsitektur internal, dan penegasan karakteristik kelenjar, serta evaluasi jaringan lunak perinodal dan temuan terkait kepala-leher. Diffusion-Weighted Imaging (DWI) telah terbukti meningkatkan keterlihatan kelenjar getah bening subsentimeter karena penekanan jaringan latar belakang dan dapat membantu dalam mendeteksi kelenjar getah bening relatif terhadap urutan konvensional(5). Meskipun dengan berbagai keuntungan yang ada, pada penggunaan CT harus tetap memperhitungkan risiko radiasinya. Selain itu, penggunaan sedasi pada bayi dan anak-anak juga perlu dipertimbangkan ketika akan dilakukan pemeriksaan dengan menggunakan CT ataupun MRI.

2. Kelenjar Getah Bening Reaktif

Kelenjar getah bening reaktif kemungkinan disebabkan oleh infeksi virus, bakteri, jamur, atau protozoa. Kelenjar yang seperti ini umumnya sedikit membesar dan mungkin menunjukkan *enhancement* ringan di CT atau MRI dan USG Doppler menunjukkan vaskularisasi memancar dari hilus (4).

Kelenjar getah bening reaktif paling banyak disebabkan oleh virus(6) dan biasanya mengakibatkan pembesaran kelenjar getah bening serviks bilateral tanpa periadenitis. Virus yang paling umum menginfeksi adalah *cytomegalovirus, herpes simplex virus, varicella, rubeola (measles)*. Untuk memastikan diagnosi, umumnya akan dihubungkan dengan hasil pemeriksaan klinis dan laboratoris.

Kelejar getah bening reaktif akibat bakteri umumnya disebabkan oleh *Staphylococcus aureus* dan kelompok *A Streptococcus* (7). Biasanya akan tampak sebagai pembesaran kelenjar dengan perubahan peradangan perinodal (8).

Infeksi akibat jamur mungkin ada di daerah endemik atau pada pasien *immunocompromised*. Jenis jamur yang umumnya menyebabkan infeksi adalah *cryptococcosis, coccidiomycosis,* dan *histoplasmosis.* Protozoa yang diketahui menyebabkan kondisi ini limfadenitis adalah toxoplasmosis (4).

a. Infeksi Bakterial

Limfadenitis servikal dan 53-89% kasus adenitis servikal unilateral disebabkan oleh infeksi bakteri *Staphylococcus aureus* dan *group A Streptococcus—Staphylococcus aureus* dan *group A Streptococcus* (7). Infeksi ini umum ditemui pada anak usia 1-4 tahun. Infeksi ini menyebabkan pembesaran kelenjar dengan perubahan inflamasi perinodal dan dapat berkembang menjadi adenopati supuratif. Kondisi ini didefinisikan sebagai infeksi yang mengakibatkan nekrosis dalam kelenjar getah bening (juga disebut sebagai pembentukan abses intranodal)(8,9).

Gambaran adenopati supuratif di ultrasonografi adalah daerah anechoic, vaskularisasi perifer, dan mungkin septasi dan peningkatan akustik atau posterior (10). Nodus supuratif pada CT menunjukkan bahwa nodus mengalami hipoatenuasi di sentral, dengan peningkatan tepi perifer dan perubahan inflamasi perinodal. MRI menunjukkan pusat T1 hipo dan hiperintensitas T2, dengan peningkatan perifer. Perubahan inflamasi perinodal terkait dapat membantu dalam diferensiasi dari nekrosis nodal sentral karena penyakit metastasis, yang sebaliknya dapat memiliki tampilan pencitraan yang serupa.

Keterlibatan kepala-leher dengan infeksi *Mycobacterium tuberculosis* mencakup sekitar 12-15% dari kasus tuberculosis ektraparu (9,11). pada fase akut, *tuberculous granuloma* mungkin memunculkan pembesaran dan penegasan nodul. Penyakit subakut ditandai oleh formasi nodul supuratif dan abases

intranodal (8,11). Kalsifikasi nodus dapat terlihat pada fase kronis atau setelah pengobatan, meskipun kalsifikasi di dalam nodus servikal jauh lebih jarang daripada di nodus limfa mediastinum atau hilus (12). Node level II dan V paling sering terlibat(8,9,11).

Ultrasound, CT, dan MRI bisa menggambarkan semua tahapan penyakit. Penyakit subakut paling sering ditemui pada pencitraan dan ditandai dengan pembentukan abses intranodal, yang secara klasik tidak memiliki perubahan inflamasi perinodal (8,11). Karena kurangnya periadenitis pada tuberkulosis, adenopati metastasis merupakan diagnosis banding utama dan aspirasi jarum halus mungkin diperlukan untuk diagnosis. Ketika adenitis tuberkulosis dicurigai, pencitraan dada harus dilakukan untuk menilai apakah ada penyakit paru aktif (8,9,11).

Limfadenitis regional sekunder akibat infeksi *Bartonella henselae* (sebelumnya Rochalimaea), juga disebut sebagai penyakit garukan kucing, paling sering menyerang anak-anak dan dewasa muda. Sebagian besar kasus terkait dengan cakaran atau gigitan kucing, dengan limfadenopati regional diidentifikasi sekitar 3 minggu setelah inokulasi. Limfadenopati servikal lokasi ketiga paling umum setelah nodus aksila dan epitroklear (13). Keterlibatan nodus kepala dan leher yang terisolasi terjadi pada 25% kasus, seringkali dengan keterlibatan nodus soliter (14).

Karena riwayat paparan sering tidak diketahui, anak-anak bisa disarankan untuk menjalani pemeriksaan radiologi untuk evaluasi massa leher soliter baru. Sayangnya, temuan pencitraan pada penyakit garukan kucing bervariasi, mulai dari enhancement hingga limfadenopati nekrotik. Diagnosis dapat dikonfirmasi dengan enzim immunoassay (EIA), reaksi rantai polimerase, biopsi kulit atau nodal (13).

b. Infeksi Virus

Virus Ebstein-Barr menyebabkan mononukleosis menular (9), namun demikian, penyakit yang secara klinis mensimulasikan mononukleosis dapat disebabkan oleh virus lain. Limfadenopati secara klasik difus dan tidak memiliki perubahan inflamasi perinodal. Temuan kepala dan leher terkait dapat membantu dalam diagnosis, terutama pembesaran tonsil adenoid dan palatina (10).

Temuan pada hasil pencitraan yaitu tipikal dari nodus yang terinfeksi virus reaktif. Identifikasi multipel, lesi limfoepitel parotis bilateral (kista) menunjukkan infeksi HIV yang mendasari bila terlihat dalam hubungannya dengan limfadenopati serviks umum (8,9,15). Hiperplasia limfoid dan hipertrofi adenoid dapat terlihat tetapi mungkin tidak ada pada pasien dengan jumlah CD4 rendah karena ketidakmampuan untuk meningkatkan respons imun. Setelah mengenali temuan pencitraan tersebut, ahli radiologi mungkin menjadi yang pertama untuk meningkatkan kecurigaan infeksi HIV dan dapat memfasilitasi diagnosis dini sebelum perkembangan penyakit dan pengembangan komplikasi terkait(8,9,15).

3. Limfadenopati Dihubungkan dengan Sindroma Klinis

Limfadenopati servikal merupakan bagian dari banyak sindroma klinis yang dalam pemeriksaan radiologi dapat membantu menentukan penyebab potensial yang pada kondisi yang berhubungan dengan kepala dan leher. Lupus eritematosus sistemik, rheumatoid arthritis remaja, gangguan limfoproliferatif pasca transplantasi, dan penyakit sel sabit merupakan beberapa proses penyakit yang temuan radiologinya kurang membedakan namun bisa memberi pertimbangan dengan didasarkan pada riwayat pasien dan demografinya.

a. Penyakit Kawasaki

Penyakit Kawasaki (sindrom kelenjar getah bening mukokutan demam) pertama kali dideteksi pada anak-anak di Jepang dan sekarang juga ditemui pada bayi dan anak-anak dari semua demografi (16). Kriteria

diagnostik termasuk demam yang berlangsung setidaknya 5 hari; kurangnya bukti penyakit yang menyertai untuk menjelaskan gambaran klinis; dan memenuhi minimal empat dari lima komponen klinis, salah satunya adalah limfadenopati servikal (diameter >1,5 cm), biasanya unilateral (17).

Limfadenopati sebagai tanda yang pertama muncul pada penyakit Kawasaki bisa mengarah pada salah diagnosis sebagai limfadenitis serviks bakteri. Memeriksa gambaran pencitraan dan data klinis dapat digunakan untuk membedakan limfadenopati penyakit Kawasaki dengan limfadenitis serviks bakteri. USG dan CT merupakan modalitas yang sangat bermanfaat dalam mebedakan penyakit Kawasaki dengan limfadenitis servik bakteri (18). Pasien limfadenopati penyakit Kawasaki cenderung tidak memiliki abses pada CT dan penanda inflamasi hepatobilier sistemik dan piuria yang lebih tinggi dibandingkan dengan pasien limfadenitis serviks bakteri. Tidak adanya abses pada CT, usia yang lebih muda, dan peningkatan CRP adalah variabel paling signifikan yang membedakan limfadenopati penyakit Kawasaki dari limfadenitis serviks bakteri. Tidak ada perbedaan CAA antara limfadenopati penyakit Kawasaki dan penyakit Kawasaki tipikal (19).

b. Penyakit Kikuchi-Fujimoto

Penyakit ini juga dikenal sebagai limfadenitis nekrotikans histiositik, penyebab limfadenopati servikal yang langka dan dapat sembuh sendiri, Penderita bisanya memiliki gejala limfadenopati serviks, seringkali dengan gejala sistemik, termasuk demam, kelelahan, mual, muntah, diare, dan penurunan berat badan(20). Tidak ada pemeriksaan laboratorium untuk mendiagnosis kondisi ini, sehingga pencitraan memegang peranan penting dalam diagnosis, perencanaan pembedahan, dan tindak lanjut.

Temuan pencitraan pada penyakit Kikuchi-Fujimoto sangat bervariasi. Keterlibatan nodus servikal unilateral atau keterlibatan nodus bilateral asimetris paling khas, dengan nodus tingkat II, V, dan III paling sering terlibat. Sebagian besar nodus menunjukkan atenuasi homogen, peningkatan, dan perubahan inflamasi perinodal, dan beberapa menunjukkan nekrosis intranodal (4).

Karena diagnosis banding mencakup infeksi dan keganasan, diagnosis definitif bergantung pada biopsi. Perjalanan penyakit biasanya jinak, dengan resolusi spontan terjadi 1-6 bulan setelah onset gejala (21).

c. Penyakit Castleman

Penyakit Castleman, atau hiperplasia limfoid angiofollicular, biasanya muncul dengan limfadenopati serviks. Limfadenopati serviks terisolasi lebih sering terjadi pada subtipe vaskular hialin. Pada pasien usia muda, mereka cenderung datang dengan massa nodus serviks asimtomatik. Secara keseluruhan, mediastinum adalah situs yang paling umum diikuti oleh kepala dan leher (8,9).

Pada USG, tampak pembesaran nodus yang nyata, biasanya dengan hipervaskularitas Doppler. Peningkatan sedang hingga intens telah dijelaskan pada CT (22). Kalsifikasi nodal dideskripsikan sebagai kalsifikasi belang-belang dan "arborizing" dalam kelenjar getah bening panggul (23). Pada MRI, lesi biasanya T1 hiperintensitas relatif terhadap otot dan T2 hiperintens dengan linier, stellata T2 hipointens di tengah. Temuan hipointensitas T2 sentral berkorelasi dengan fibrosis sinusoidal, pembuluh darah, dan kalsifikasi pada histopatologi (24). Kurangnya *enhancement* sentral, indikasi fibrosis, dalam *enhancing* massa nodal pada CT telah dideskripsikan sebagai sugestif penyakit Castleman (22). Pembedahan biasanya bersifat kuratif; namun, lesi dapat muncul kembali jika eksisi tidak lengkap.

d. Penyakit Kimura

Penyakit Kimura merupakan gangguan inflamasi kronis yang mempengaruhi jaringan subkutan, kelenjar getah bening, dan kelenjar ludah. Penderita biasanya memiliki gejala berupa massa jaringan lunak yang tidak nyeri, paling sering di daerah submandibular atau parotis, dengan keterlibatan kelenjar getah bening

atau kelenjar ludah yang berdekatan (25). Eosinofilia perifer dan peningkatan kadar IgE serum merupakan gambaran laboratorium yang khas. Penyakit ini biasanya menyerang laki-laki Asia berusia 20-an hingga 30-an (25).

Karakteristik yang ditemui pada USG berupa lesi hypoechoic hipervaskular fokal dalam jaringan subkutan. Demikian pula kelenjar getah bening yang terlibat, mereka mengalami pembesaran dan hipervaskular. CT dengan kontras menunjukkan *enhancement* massa subkutan, limfadenopati servikal regional, dan lesi kelenjar ludah fokal atau infiltratif. Pada MRI, node yang terlibat menunjukkan sinyal rendah hingga menengah pada gambar berbobot T1, sinyal menengah hingga tinggi pada DWI T2 relatif terhadap otot, dan *enhancement* setelah pemberian kontras (25).

4. Neoplasia

Keganasan adalah penyebab limfadenopati serviks yang paling ditakuti. Gambaran klinis yang mencurigakan mencakup kelenjar getah bening yang keras, tidak bergerak, tidak nyeri; pembesaran nodus progresif; kurangnya respons terhadap terapi antibiotik; atau gejala sistemik merupakan gejala yang paling sering mengarah pada permeriksaan dengan pencitraan.

Gambaran sonografi limfadenopati maligna meliputi pembesaran nodus, bentuk bulat, hilus ekogenik tidak ada atau eksentrik, parenkim hipoekoik, dan kecenderungan nodus untuk beragregasi menjadi massa (26). Fitur Color Doppler, termasuk pembuluh darah subkapsular, perpindahan pembuluh darah hilus, dan tidak adanya segmen pembuluh darah nodal, telah diduga terkait dengan infiltrasi tumor (27). Peningkatan pulsatilitas dan indeks resistif juga telah digambarkan sebagai sekunder untuk kompresi pembuluh darah nodal oleh tumor infiltratif(27). Pembesaran nodus, *enhancement*, dan nekrosis intranodal tanpa periadenitis sering terjadi pada CT atau MRI. Diffusion-weighted MRI telah dilaporkan untuk membedakan antara pembesaran kelenjar getah bening jinak dan ganas berdasarkan penurunan nilai koefisien difusi pada beberapa keganasan (28). Ketika pada pencitraan yang dicurigai sebagai keganasan maka leukemia, limfoma, dan metastasis perlu dipertimbangkan.

KESIMPULAN

Pembesaran kelenjar getah bening merupakan gejala nonspesifik nodus yang sering menyulitkan dokter klinis maupu ahli radiologi. Kondisi ini paling sering disebabkan karena infeksi tetapi juga dapat dihubungkan dengan proses yang lebih agresif seperti malignan. Evaluasi klinis yang tepat sangat penting dalam penilaian pembesaran kelenjar getah bening. Pencitraan memainkan peran penting, terutama ketika kelenjar getah bening tidak memiliki fitur jinak atau gagal untuk sembuh dengan pengobatan. Pencitraan dapat mengkarakterisasi fitur nodal termasuk ukuran, distribusi, arsitektur internal, vaskularisasi, dan peningkatan. Ultrasonografi adalah modalitas awal yang sangat baik karena tidak ada radiasi pengion. CT dan MRI dapat menambahkan detail tambahan mengenai daerah dalam leher dan evaluasi patologi kepala dan leher yang terkait. Penting bagi ahli radiologi untuk mengetahui patologi nodal, terutama fitur nodal yang membantu membedakan antara penyebab dan temuan pencitraan kepala dan leher terkait untuk memandu manajemen klinis.

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Pencitraan pada Selulitis Orbita

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ABSTRACT

Orbital cellulitis is an infection of orbital soft tissue which located in the posterior orbital eptum. Infection in the posterior orbital septum will affect vision and function of the eye as well as xtra-ocular tissue. This infection can occur in children and adults, the most common cause are inusitis or nidus infection in the eyelids of the pre-septa orbital area that extends to the post-septa region, hematogenous spread is very rare. Symptoms of orbital cellulitis are characterized by pain, proptosis, chemosis, vision reduction, fever, periorbital erythema, and limitations of ocular motility. With current imaging modalities using CT scan and MRI, the diagnosis of orbital cellulitis is easy to establish so that orbital cellulitis management can be earlier and reduce complications such as vision loss or death. MRI is an excellent imaging modality for orbital cellulitis, has a better soft tissue contrast than CT scan, so it provides better contrast resolution, can determine the spreading pattern of orbital cellulitis, especially in the intracranial, such as intra-axial abscess, epidural empyema, subdural empyema and cavernous sinus thrombosis.

ABSTRAK

Selulitis orbita adalah infeksi pada jaringan lunak orbita yang terletak di posterior septum orbita. Infeksi di posterior septum orbita akan mempengaruhi penglihatan dan fungsi orbita serta jaringan ekstraokuler. Infeksi ini bisa terjadi pada anak dan dewasa, penyebab tersering dari sinus atau dari nidus infeksi di kelopak mata daerah pre septa orbita yang meluas ke post septa orbita, penyebaran secara hematogen sangat jarang. Gejala selulitis orbita ditandai dengan rasa sakit, proptosis, kemosis, pengurangan penglihatan, demam, eritema periorbital, dan keterbatasan motilitas okular. Modalitas imejing saat ini dengan menggunakan CT scan dan MRI, diagnosis selulitis orbita mudah ditegakkan sehingga management selulitis orbita bisa lebih awal dan mengurangi komplikasi seperti kehilangan penglihatan ataupun kematian. MRI merupakan modalitas imejing yang sangat baik untuk selulitis orbita, mempunyai soft tissue contrast yang lebih baik dibanding CT scan, sehingga memberikan resolusi kontras yang lebih baik, dapat menentukan pola penyebaran selulitis orbita, terutama di intracranial, seperti abscess intraaxial, epidural empyema dan thrombosis sinus cavernosus.

PENDAHULUAN:

Selulitis orbita merupakan infeksi orbita yang melibatkan jaringan adnexa orbita di posterior septum orbita [1–3], septum orbita memisahkan selulitis presepta dengan selulitis orbita yang berpotensi berbahaya [1,2]

Penyebab tersering adalah bakteri, kadang jamur dan jarang kerena infeksi virus

Sumber infeksi tersering berasal dari sinus paranasalis, tersering sinusitis ethmoidalis diikuti sinusitis maxillaris dan frontalis, infeksi bisa juga dimulai dari presepta yang meluas ke post septa.

Proses infeksi bisa terjadi: [3–6]

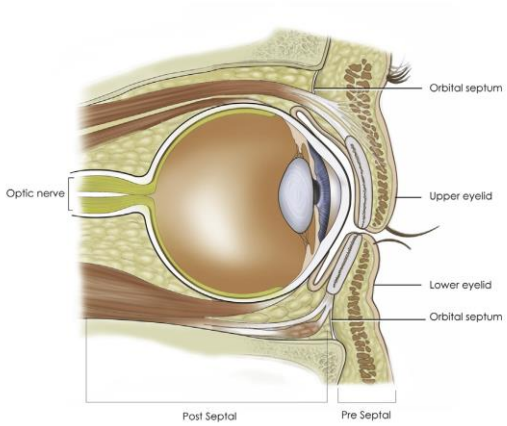
- Inokulasi langsung, misalnya karena gigitan serangga, trauma, penyebab tersering Streptococcus aureus.
- Infeksi jaringan di sekitar orbita, misalnya sinusitis, dacryocystitis, hordeolum yang bisa menyebar ke daerah preseptal dan post septal.
- Infeksi bisa juga malalui hematogen, misalnya otitis media atau pneumonia.

Infeksi postseptal memiliki tingkat komplikasi yang lebih tinggi seperti penyebaran intrakranial, meningitis, dan trombosis sinus kavernosus, yang berpotensi mengancam jiwa, perlu deteksi dini dengan MRI dan manajemen agresif. Identifikasi abses orbita juga penting karena mungkin memerlukan intervensi bedah [7–9]

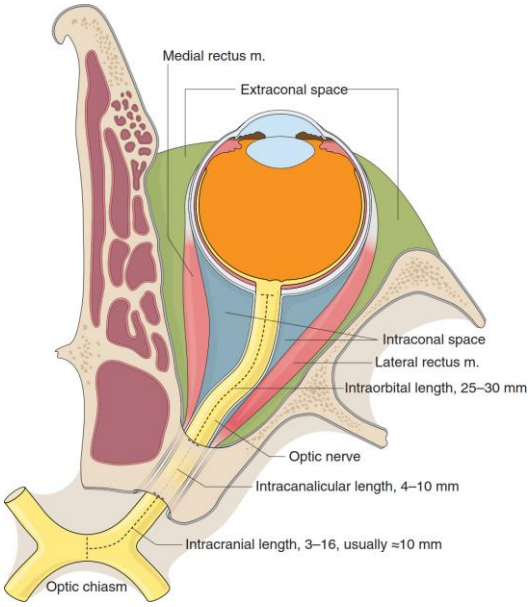
Tabel 1: Preseptal dan post septal atau selulitis orbita [10]

	Selulitis Preseptal	Selulitis Orbita
Edema kelopak mata	(+)	(++)
Chemosis	(-)	(+)
Pupil	Normal	Bisa terkena
Motilitas okuler	Intak	Restriksi, nyeri pada pergerakan bola mata
Visus	Sedikit menurun karena edema palpebra	Sangat menurun
Proptosis	(-)	(+)
Color vision	Intak	Terganggu
Lapang pandang	Intak	Kontraksi

Anatomi orbita:



Gambar 1: Anatomi Orbita [6] menerangkan preseptal dan post septal.



(Illustration by Mark Miller), aao.org

Gambar 2: Intraconal, muscle cone dan extraconal orbita.

Pencitraan pada selulitis orbita:

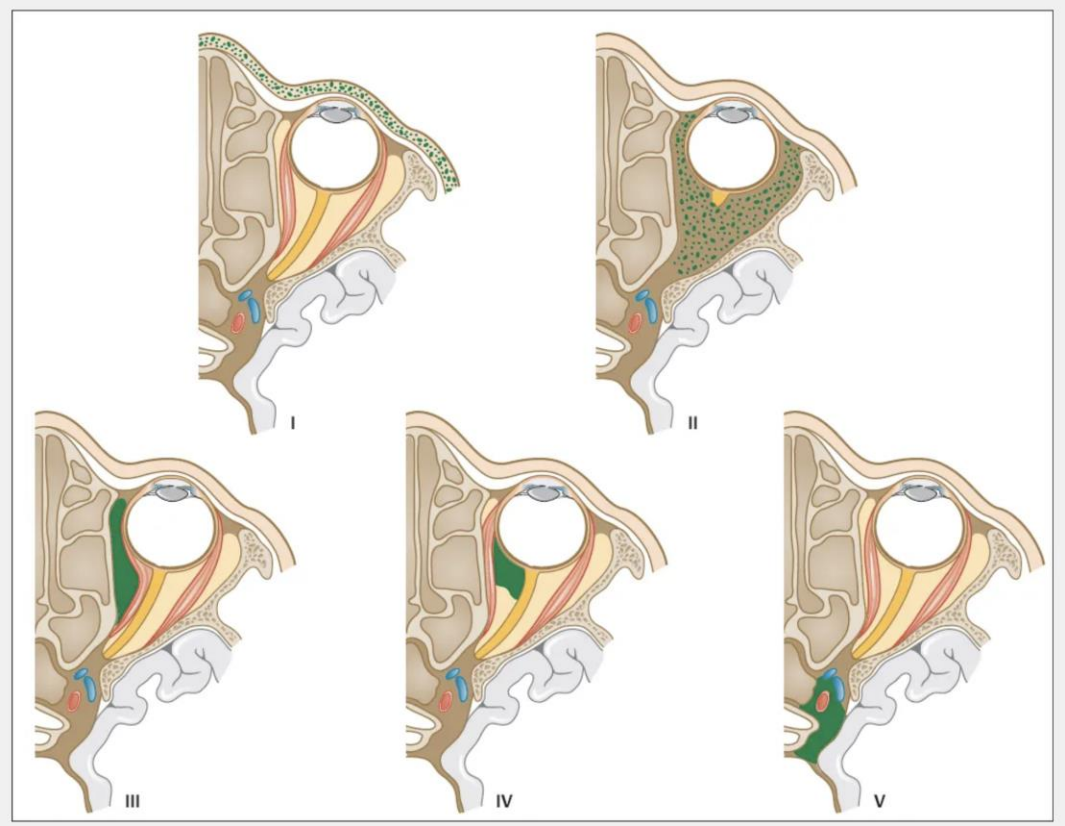
USG: Seringkali tidak terdiagnosis

CT Scan dengan kontras, dengan bone window dan soft tissue window, menunjukkan lokasi yang tepat, dapat membedakan selulitis preseptal dan selulitis orbita atau post septal.

MRI: Baik untuk mengevaluasi N. opticus, apeks orbita, ekstensi intracranial misalnya daerah sinus cavernosus. MRI mempunyai *soft tissue contrast* yang baik dan *sequence* DWi dengan ADC dan *advanced MR imaging* yang mampu mendiagnosis infeksi ataupun lesi2 lain yang mirip infeksi. MRI berguna untuk diagnosis awal selulitis orbita dan terutama berguna untuk melihat ekstensi ke intracranial. Bila Klinis curiga adanya pembentukan abscess namun CT scan tidak dijumpai, maka perlu dilanjutkan dengan MRI.

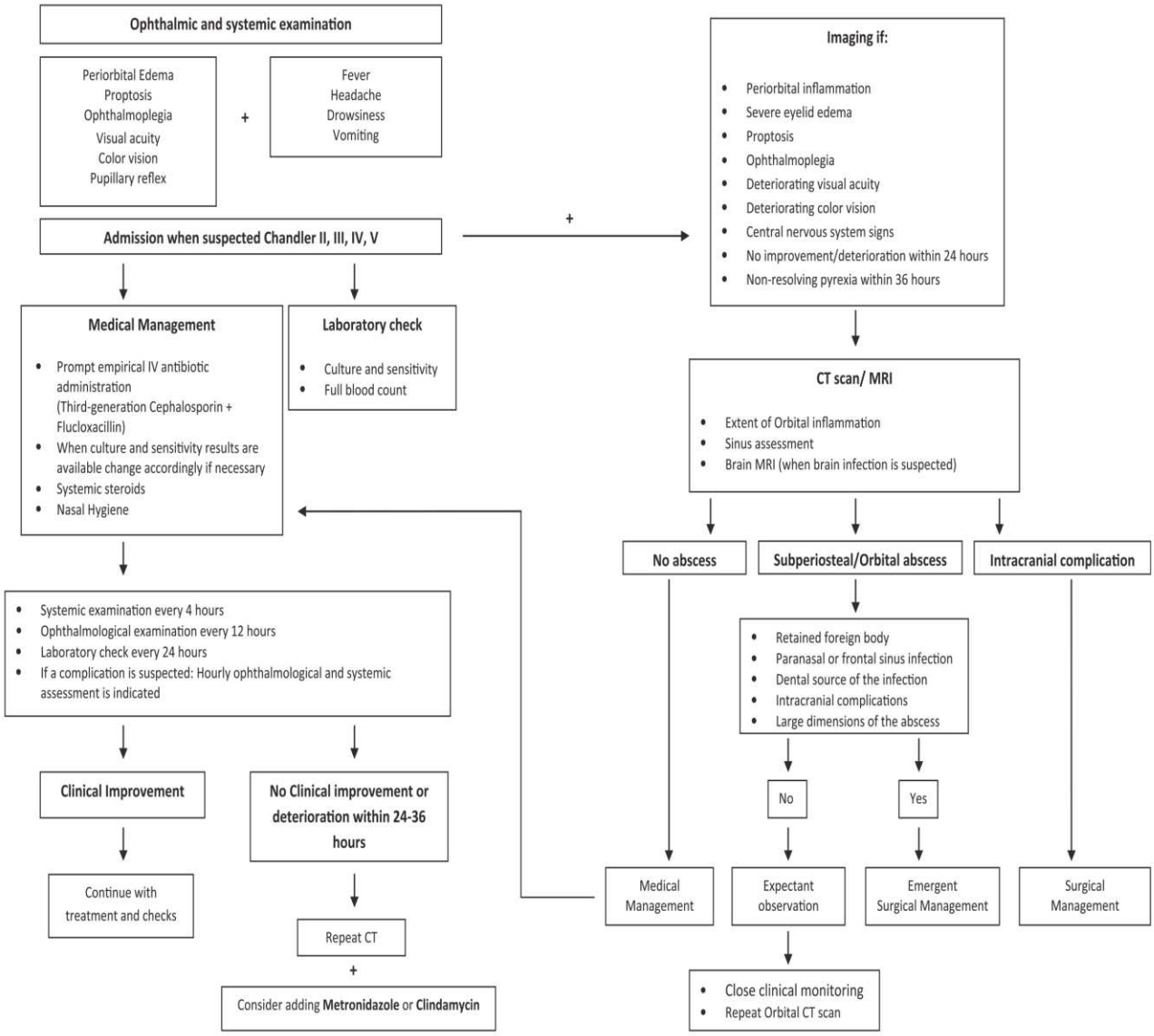
Diagnosa banding selulitis orbita: [11,12]

- Disfungsi endokrin: Thyroid-associated orbitopathy
- Inflammasi idiopatik: Myositis orbita, pseudotumor orbita, Wegener granulomatosis
- Carotico cavernous fistula
- Neoplasma dengan inflammasi - Burkitt lymphoma, histiocytosis X (Letterer-Siwe), leukemia, metastatic carcinoma, retinoblastoma, rhabdomyosarcoma, sarcoidosis.
- Thrombosis sinus cavernosus

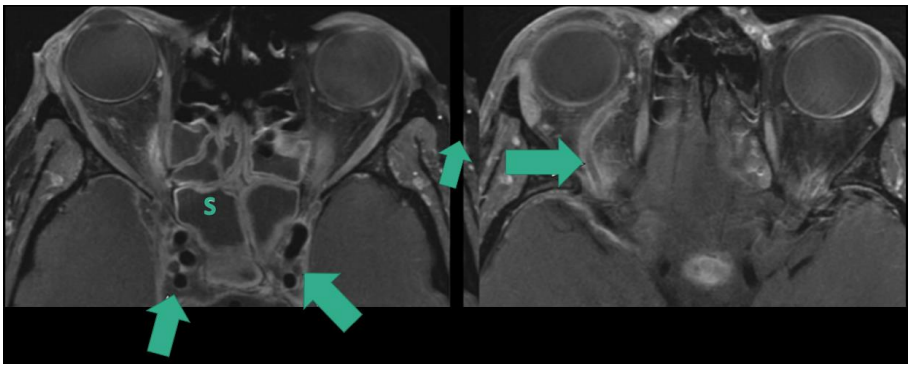


Gambar 3: Klasifikasi Chandler pada komplikasi rhinosinusitis akut. Group I: Selulitis preseptal; group II: Selulitis orbita/ post septal; gropu III: Abscess subperiosteal ; Gropu IV: Abscess intraorbital; Group V: Thrombosis sinus cavernosus [13]

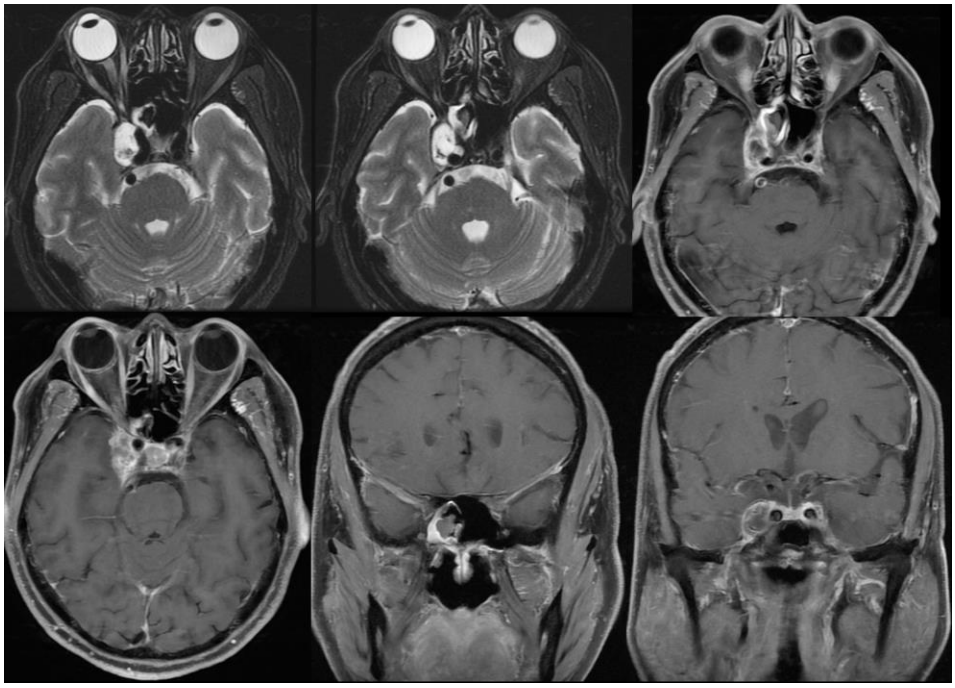
Guideline selulitis orbita:[3]



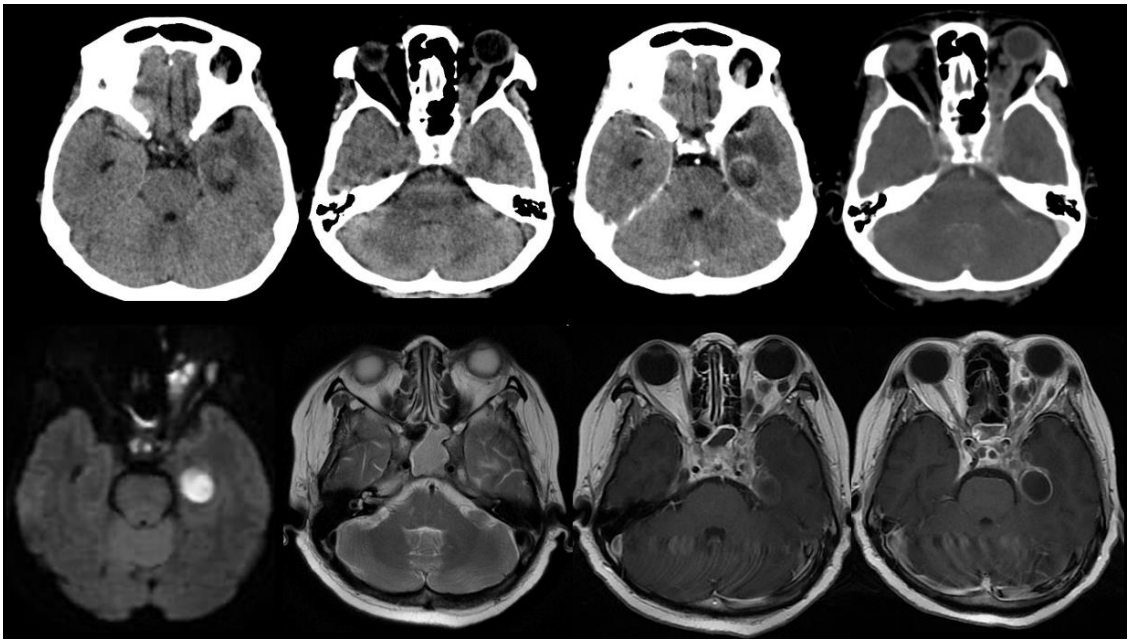
Kasus:



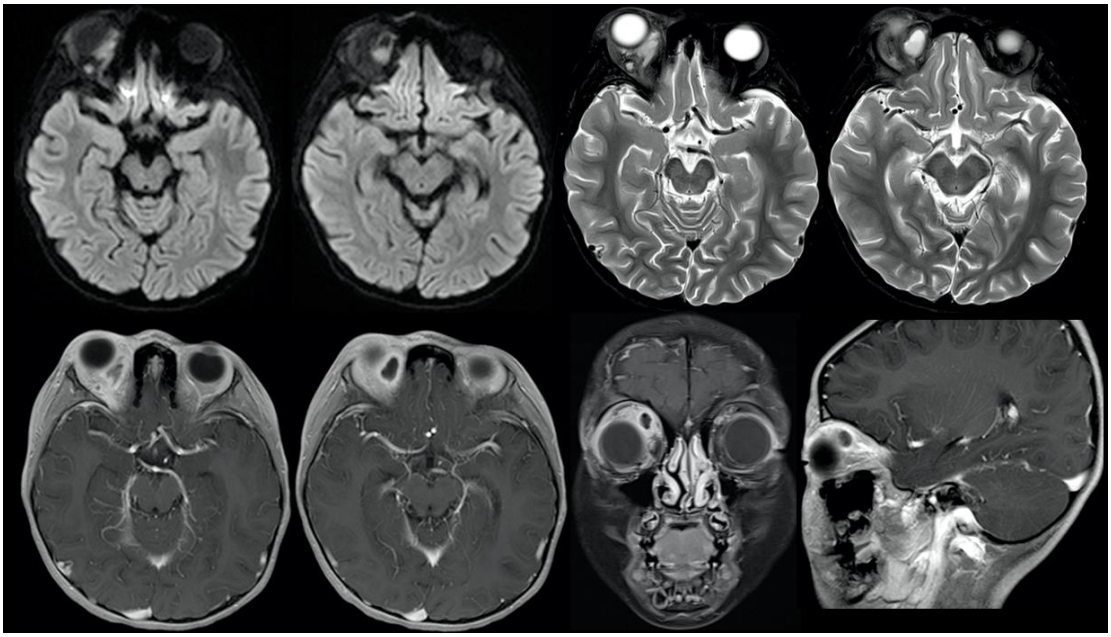
Gambar 4: Thrombosis sinus cavernosus bilateral sebagai infeksi percontinuitatum dari sinusitis sphenoidalis, dengan kontras menunjukan *filling defect* di sinus cavernosus bilateral dan tampak adanya *rim contrast enhancement* di vene ophthalmica superior sesuai dengan thrombophlebitis [14].



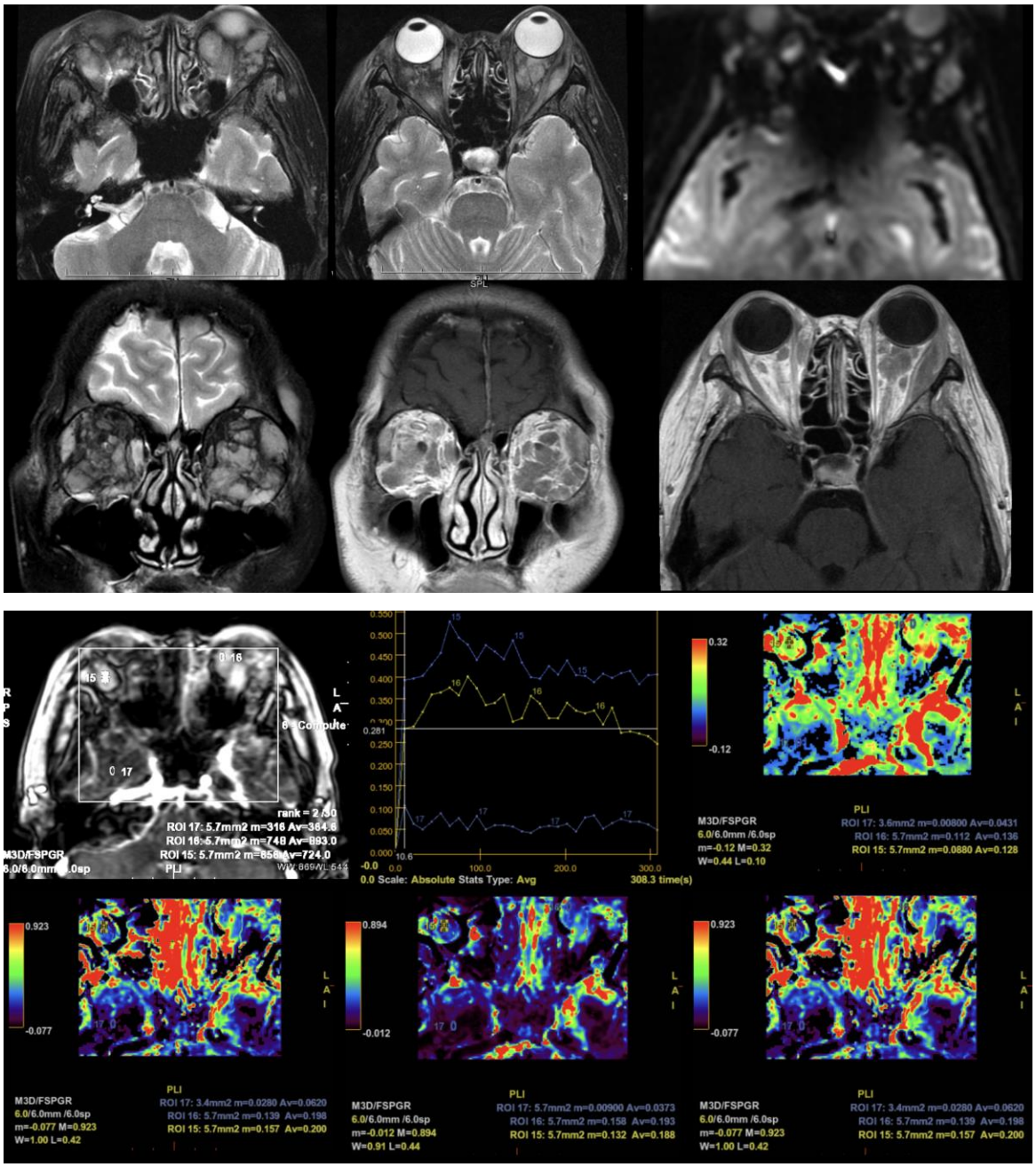
Gambar 5: Wanita, 40 tahun dengan keluhan nyeri kepala dan penglihatan kabur mata kanan, T2FSEFS menunjukkan perselubungan dengan *rim hyperintense* di sinus sphenoidalis kanan, *hyperintense signal* dengan *filling defect* di sinus cavernosus kanan, pada T1FS kontras menunjukkan rim contrast enhancement di sinus sphenoidalis kanan dan filling defect dengan *rim contrast enhancement* di sinus cavernosus kanan, sesuai dengan sinusitis sphenidalis kanan disertai thrombosis sinus cavernosus kanan. (Sri Andreani Utomo).



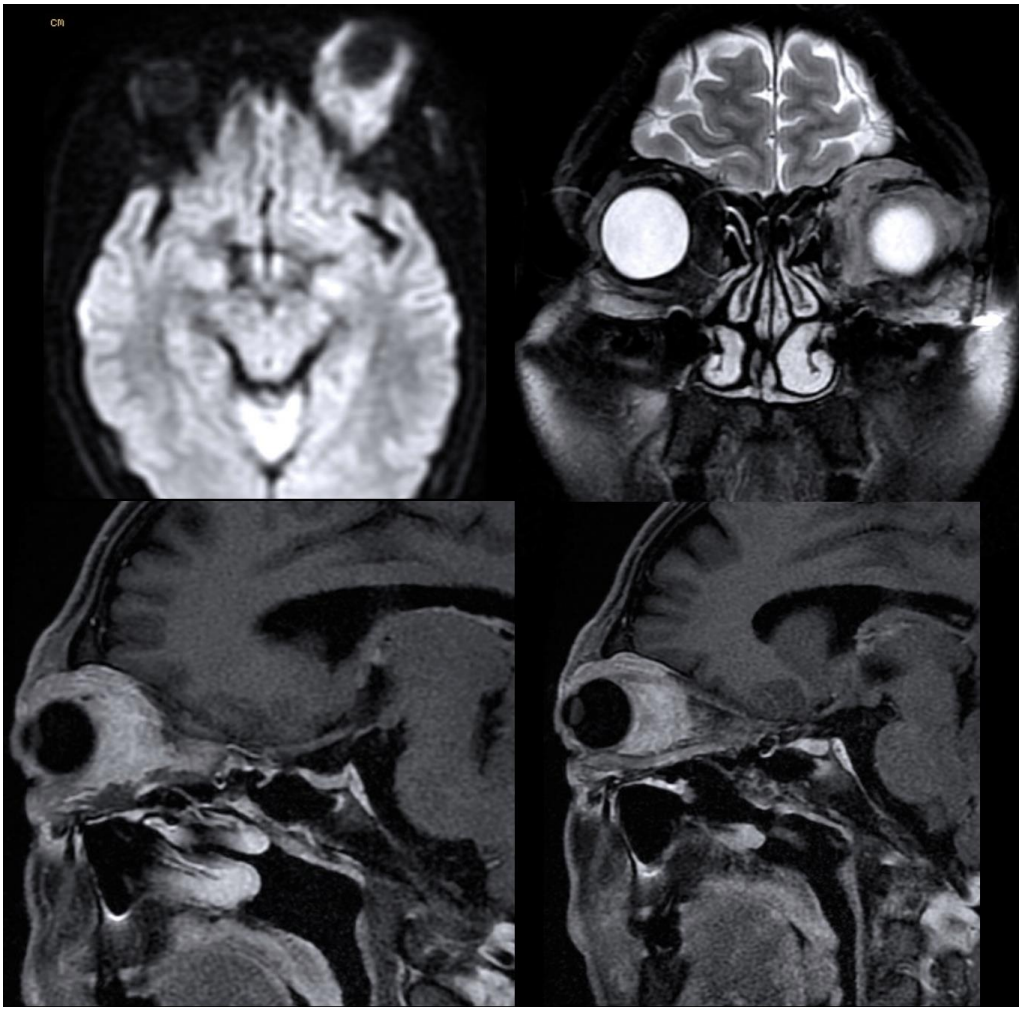
Gambar 6: Laki2, 40 th dengan mata merah, nyeri kepala dan ganguan penglihatan mata kiri, pada CT Scan kepala tanpa dan dengan kontras tampak multiple lesi di post septal orbita kiri, daerah muscle cone, intraconal hingga sinus cavernosus kiri, epidural space temporal kiri, dan intraaxial, MRI menunjukkan gambar yang lebih jelas berupa selulitis orbita di post septal intraconal, muscle cone orbital fat thrombosis sinus cavernosus kiri, epidural empyema temporal kiri dan intraaxial abscess di temporal kiri dengan penyebab sinusitis sphenoidalis kiri. Abscess menunjukkan *restricted diffusion* di DWI (Sri Andreani Utomo).



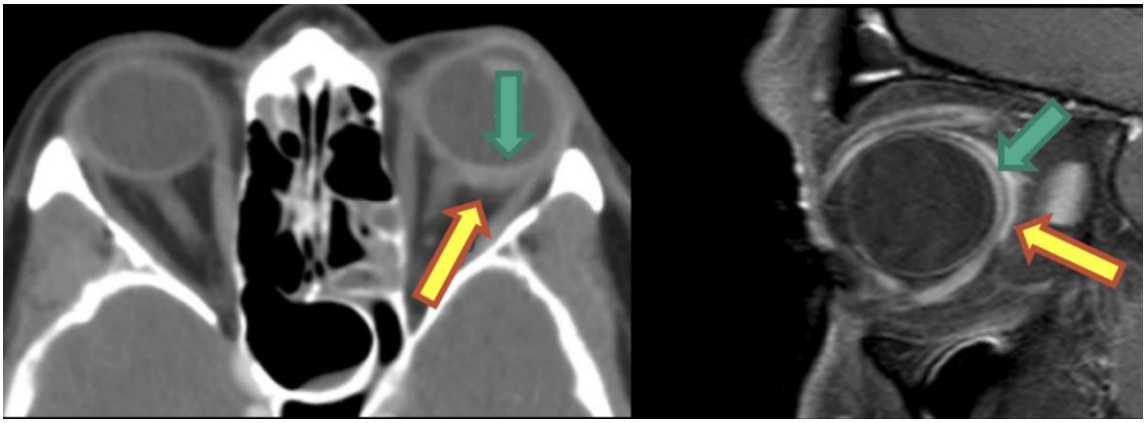
Gambar 7: Laki2, 45 tahun dengan proptosis, nyeri dan ganguan penglihatan mata kanan, MRI orbita menunjukkan lesi dengan restricted diffusion di M. obliqus superior, M. rectus lateralis dengan kontras menunjukkan *rim contrast enhancement* sesuai dengan selulitis orbita disertai abscess di M. rectus lateralis dan M. obliqus superior (Sri Andreani Utomo).



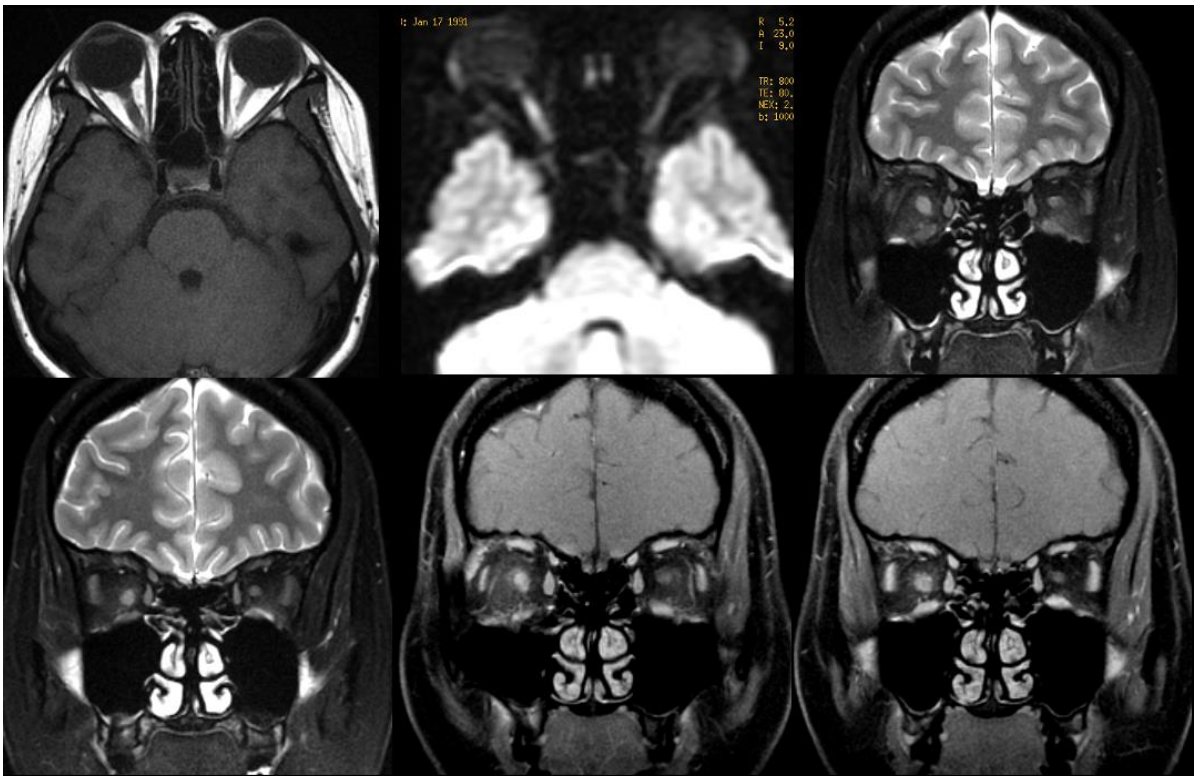
Gambar 8: Wanita, 47 tahun dengan gangguan penglihatan kedua mata, MRI T2FRFSE menunjukkan multiple lesi *iso* hingga *slight hypointense* T2 di extraconal, intraconal post septal orbita kanan kiri, DWI menunjukkan restricted diffusion dan dengan pemberian kontras tampak *slight heterogenous* dan *rim contrast enhancement*. Advanced MRI dengan DCE perfusion menunjukkan TIC type 3, permeability study menunjukkan peningkatan Ktrans, Kep, IAUGC dan Ve. Gambaran sesuai dengan keganasan, multiple nodules metastasis. DCE= Dynamic contrast enhanced, TIC= Time intensity curve, Ktrans dan Kep: transfer constant sesuai dengan wash in dan wash out, IAUGC= Initial area under gadolinium contrast, Ve: Volume extravascular extracellulare. (Sri Andreani Utomo).



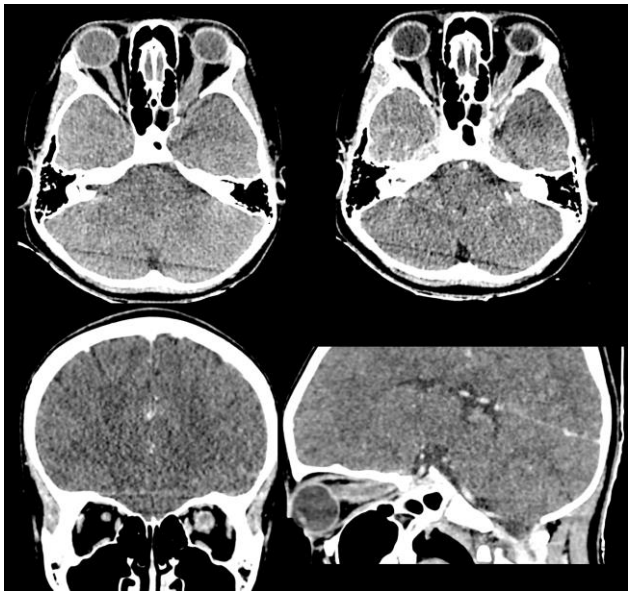
Gambar 9: Wanita, 40 tahun dengan pembengkakan di kelopak mata kiri, MRI menunjukkan massa dengan *restricted diffusion* pada DWI, pada T2 massa tampak *slight hypointense* dan dengan pemberian kontras tampak hampir *homogenous contrast enhancement*, sesuai dengan lymphoma maligna (Sri Andreani Utomo).



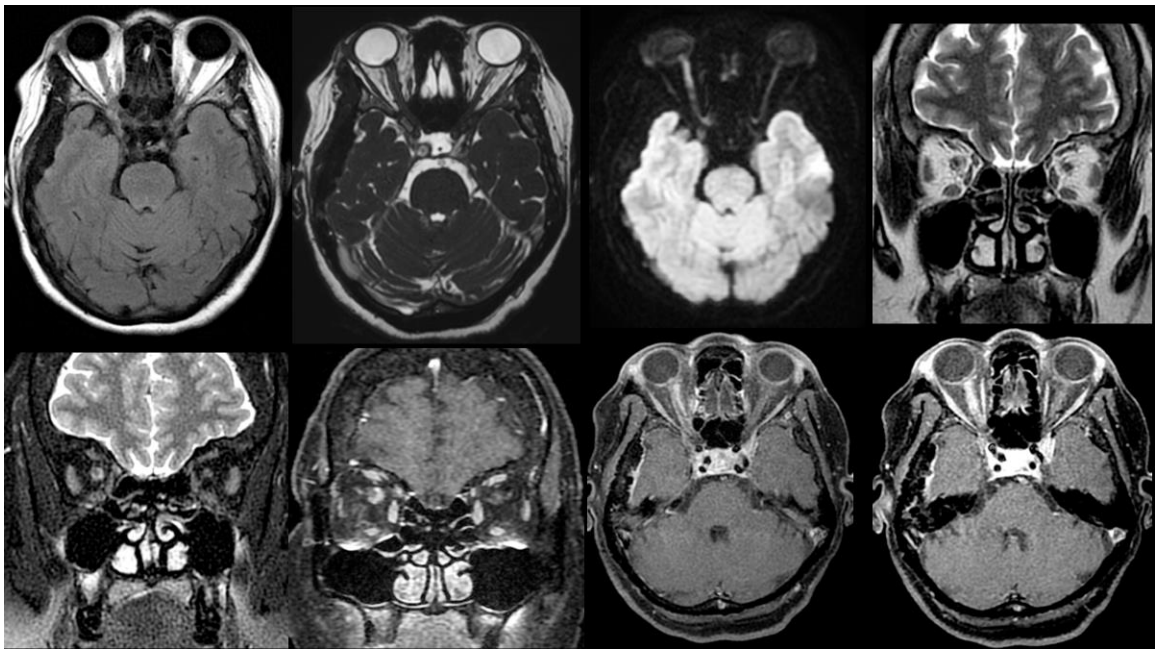
Gambar 10: Scleritis CT vs MRI, pada CT scan tampak penebalan sclera, tidak bisa membedakan penebalan sclera dengan choroidal, pada MRI tampak jelas sclera yang menebal terpisah dengan penebalan choroidal dengan minimal efusi di suprachoroidal [15]



Gambar 11: Wanita, 23 tahun dengan gangguan visus mata kanan, MRI menunjukkan penebalan N. opticus kanan, hyperintense T2 dan tampak lesi dengan restricted diffusion di N. opticus kanan yang dengan kontras menunjukkan *contrast enhancement* yang homogen, sesuai dengan neuritis optica (Sri Andreani Utomo).



Gambar 12: Anak laki-laki, 4 tahun dengan gangguan visus penglihatan mata kiri, historis post ALL (Acute lymphoblastic leucema) post khemoterapi, CT scan menunjukkan bulging N. opticus kiri dengan *heterogenous rim contrast enhancement*, sesuai dengan metastasis ALL di N. opticus kiri (Sri Andreani Utomo).



Gambar 13: Wanita, 42 tahun dengan nyeri kepala dan gangguan penglihatan mata kanan, MRI kepala menunjukkan lesi dengan penebalan N. opticus kanan, *restricted diffusion* pada DWI, dengan kontras menunjukkan rim contrast enhancement, tampak juga hyperostosis os temporal dan processus zygomaticus orbita kanan disertai *enplaque contrast enhancement*, sesuai dengan optic meningioma dan enplaque meningioma di konveksitas temporal kanan. (Sri Andreani Utomo)

KESIMPULAN:

CT Scan dengan reformat axial dan coronal baik untuk membedakan preseptal dan post septal atau selulitis orbita. MRI merupakan modalitas imejing yang sangat baik untuk selulitis orbita, mempunyai soft tissue contrast yang lebih baik dibanding CT scan, sehingga memberikan resolusi kontras yang lebih baik, dapat menentukan pola penyebaran selulitis orbita, terutama di intracranial, seperti abscess intraaxial, epidural empyema dan thrombosis sinus cavernosus.

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Imaging of CNS Infections

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INTRODUCTION

The central nervous system (CNS) is vulnerable to infectious agents due to several factors,including:

- lack of a true lymphatic system in the brain and spinal cord;
- the anatomy of the subarachnoid space, which offers little resistance to the spreadof infection;
- the flow of the cerebrospinal fluid (CSF), which facilitates infection spread over thebrain and into the ventricles.

Early diagnosis and prompt treatment are important for patient survival, since CNS infections are associated with a high morbidity and mortality, and, for survivors, there is asignificant risk of permanent damage.

The diagnosis of CNS infections rests on 3 pillars: clinical presentation, laboratory, andimaging findings.

The **clinical presentation** of most CNS infections is relatively non-specific, though the patients are often severely ill. Symptoms include fever, headache, seizures, meningeal signs, lethargy, stupor. Neurological symptoms depend on the precise location and extent of the infection.

Laboratory findings in the CSF include elevated WBC (lymphocytes in viral infection), elevated protein levels and positive PCR (viral: herpes, enterovirus). Laboratory findings onperipheral blood samples include increased erythrocyte sedimentation rate (ESR) and increased white blood cell count (leucocytosis).

Imaging findings will be discussed throughout this paper for different types of infections.

TERMINOLOGY

Terminology plays an important role in communicating imaging findings with clinicians. Radiologists should understand the intricate terminological details to correctly describe CNSinfections and avoid confusion.

- CEREBRITIS indicates a purulent nonencapsulated parenchymal infection of the brainand is most commonly caused by bacterial infections. On CT, the features are nonspecific (ill-defined area of low attenuation with peripheral enhancement). Often, it is difficult to distinguish from a brain tumor.
- ENCEPHALITIS is used to describe a more diffusely spread inflammation of the brain, either caused by a (viral) infection or an auto-immune process.
- MYELITIS refers to an inflammation of the spinal cord. Myelitis can be subdivided into several categories depending on the location or the etiology of the lesion.
- ENCEPHALOMYELITIS is used when both the brain and the spinal cord are involved. Probably the best know example is ADEM (acute disseminated encephalomyelitis) which is a postinfectious demyelinating disease involving the brain and spinal cord, likely triggered by viral infection.
- MENINGITIS signifies inflammation of the meninges and fluid spaces surrounding the brain and spinal cord. It can be subdivided into:

- Leptomeningitis denotes inflammation of the subarachnoid space and leptomeninges (pia mater and arachnoid), and often manifests as inflammatory exudate of the pial and arachnoid membranes; it is more frequent than pachymeningitis.
- Pachymeningitis, signifying involvement of the pachymeninges (dura mater),manifests usually as epidural or subdural EMPYEMA. On MRI it is seen as a focal or diffuse thickening of the dura mater, indicating persistent inflammation.

- A CEREBRAL ABSCESS is defined as a suppurative inflammatory process with centralliquefactive necrosis (pus), encased by granulation tissue; it is the end stage of an untreated cerebritis and typically occurs with bacterial infections.

Congenital brain infections are often indicated with the acronym ToRCH, which stands forToxoplasmosis, Rubella, Cytomegalovirus, and Herpes simplex virus-2. Haematogenous transmission may occur at any time during gestation or occasionally at the time of delivery via maternal-to-fetal transfusion. Congenital HIV infections can occur in utero, at delivery orby breastfeeding.

VIRAL INFECTIONS

Viral infections can involve one or several anatomic compartments of the CNS. In patients with viral meningitis, mostly due to enterovirus infections, imaging findings are often non- specific and can be normal in the initial phase of the disease. Based on the distribution of abnormalities on diffusion-weighted images (DWI) or T2-weighted images (T2-WI), several patterns may be discerned. A particular virus can cause variable brain MRI findings across different microbiomes, and, conversely, a particular appearance on MRI may be caused by avariety of pathogens.

Acute encephalitis is often caused by herpes simplex virus (HSV), though there are many other viruses that can involve the brain, including cytomegalovirus (CMV), Epstein Barr virus (EBV) and varicella zoster virus (chickenpox). Subacute and chronic encephalitis are rare conditions, which can present as Rasmussen encephalitis or subacute sclerosing panencephalitis. Following a viral infection (or vaccination with a live attenuated virus) it is possible to see encephalitis or encephalomyelitis, which is a neurological, immune-mediated disorder in which there is widespread inflammation of the white matter brain and spinal cord.

Herpes encephalitis

Herpes encephalitis is the most common encephalitis, especially in children!!

The organism (virus) can be HSV type I (in adults) or HSV type II (in neonates fromtransplacental infection).

Clinical findings are initially relatively non-specific and may include a receding viral syndrome, low grade fever, headache, seizures. When the disease evolves, it may lead to mental status changes, confusion, disorientation, hallucination, personality change, behavioral disturbances, lethargy and seizures. HSV-encephalitis is a medical emergency dueto high morbidity and mortality. The diagnosis is confirmed by a positive PCR test in CSF!!

For the detection of abnormalities, MRI more sensitive than CT. The hallmark finding of the disease are T-2 hyperintense areas in the temporal lobe, insular cortex, orbital surface of the frontal lobe and cingulate gyrus. This may be accompanied by inflammatory swelling and petechial haemorrhages. There may be variable enhancement, usually occurring after 3 days (in a gyral pattern). Typically, areas of diffusion restriction are present as high signal intensity changes on DWI.

Differential diagnosis (DDx) in bilateral temporal involvement includes: gliomatosis cerebri, SLE, limbic encephalopathy, enterovirus infections.

Varicella zoster encephalitis

In the vast majority of cases, chickenpox which is caused by the varicella zoster virus (VZV),is a mild disease that causes an itchy, blistering skin rash and mild fever. Recognition is usually self-limiting, and lasts for a short time in healthy children, though it can be more severe in adults. Rarely, in approximately one in 33,000 patients, individuals infected by chickenpox can develop encephalitis, meningoencephalitis, or transverse myelitis.

Symptoms include fever, headache, seizures, and acute cerebellar ataxia, often around 10 days after onset of the rash. A definite diagnosis is made through the varicella specific IgM in serum or PCR in CSF.

MRI may reveal diffuse cerebellar swelling and T2 hyperintensity, which are symptomatic ofacute cerebellitis. Other findings include multifocal leukoencephalopathy, characterised by small T2 hyperintense lesions in the cortex and subcortical white matter (small vessel arteriopathy), and basal ganglia infarctions (due to vasculitis, unilateral (after 1-4 months)).

CMV encephalitis

Cytomegalovirus (CMV) encephalitis one of the most frequent prenatal infections (congenital CMV infection). In adults, CMV infection is almost exclusively seen in patients who are profoundly immunosuppressed.

Clinically, most infants infected with CMV will have no permanent health consequences. However, in a small number of cases, congenital CMV can cause long-term neurodevelopmental sequelae, including mental retardation, cerebral palsy, and sensorineural hearing loss (SNHL). Even with antiviral therapy, these injuries are often irreversible. On CT, intracranial calcifications are the most commonly observed imaging finding of congenital CMV infection, occurring in 30%–70% of patients. On MRI, findings are usually including T2/FLAIR high signal intensity changes in the periventricular white matter. If ventriculitis is also present, then enhancement of the ependymal surface and hydrocephalus can be seen.

Rasmussen encephalitis

Rasmussen encephalitis is a progressive disease, typically involving children between the ages of 6 to 8. The aetiology remains unclear: viral? autoimmune? Clinically, Rasmussen encephalitis is characterised by severe epilepsy and hemiplegia. The condition is typically unilateral. On MRI, lesions are found in the basal ganglia, and there may be cerebral corticalswelling in the insular regions, evolving towards progressive and irreversible brain atrophy.

Subacute sclerosing panencephalitis (SSPE)

Subacute sclerosing panencephalitis (SSPE) is a slow virus infection occurring several years after a primary measles infection, usually before the age of two years. SSPE has become much less prevalent, due to the growing importance of measles vaccination. The age peak is seen in children between seven and nine years old. SSPE leads to a progressive psychoneurological deterioration, usually with death ensuing within three years.

Imaging findings depend on the stage of the infection. Initially, up to three to four monthsafter infection, imaging findings are normal. Subsequently, patchy asymmetrical T2 high signal intensities occur in the parietal and temporal lobes, first involving the peripheral cortex and white matter, later the deep white matter and corpus callosum. Finally, diffuseatrophy and use come up with severe shrinking of the brain.

BACTERIAL INFECTIONS

Bacterial meningitis

Bacterial meningitis constitutes one of the most severe infectious processes of the CNS, regularly encountered in paediatric patients. The etiologic agents vary with the age of the patient. In neonates, group B streptococcus (45-50

%), E. coli (15-20 %), Staph., Listeria areencountered. In children and adults, H. influenzae, Neisseria meningitidis, Strept.

Pneumoniae are more frequently seen.

The infection is caused by hematogenous spread (through the choroid plexus), direct implantation (e.g. trauma, VPS, CSF leak, …), extension of a local disease (e.g. sinusitis,mastoiditis, otitis), or spread along the peripheral nervous system

Symptoms in neonates include fever, poor feeding, somnolence, vomiting, seizures, etc.

In older patients, headaches, somnolence, meningeal irritation (Kernig and Brudzinski sign) are more frequent.

The diagnosis is based on clinical signs and CSF analysis. MRI should only be performed when the neurological findings are unclear, when the patient is non-responsive to therapyor when complications occur. Imaging findings depend on the neuropathologic stage. The MRI appearance may rapidly change from normal to severe brain oedema in a few days, evolving towards multiple infarcts and atrophy in a few weeks, especially in newborns dueto the vulnerability of the immature brain.

Imaging findings in **stage 1 / 2** (choroid plexitis/ ventriculitis) include:

- plexus adhesion to ventricular wall
- ependymal enhancement
- intraventricular debris in the occipital horns
- hydrocephalus due to obstruction of the 4th ventricle, foramina or aqueduct
- periventricular oedema

Imaging findings in **stage 3** (arachnoiditis, meningitis) include

- purulent exudation in the subarachnoid space covering the cranial base (H. influenzae) or sometimes the cerebral convexities (pneumococcal meningitis)
- Dural or leptomeningeal enhancement
- These findings are often not recognised during the course of the disease

Imaging findings in **stage 4** (vasculitis, involvement of the perivascular spaces) include

- Involvement of the perivascular spaces is always present in neonatal bacterial meningitis! This may lead to infarctions, preferentially occurring at the cerebral cortex and subcortical white matter but also basal ganglia and periventricular white matter.
- Cerebral infarctions are seen in up to 30 % of patients with bacterial meningitis
- Involvement of the arterial system (arteritis) can lead to cerebral arterial infarction
- Laminar cortical necrosis and narrowing of the arteries peripherally
- Less commonly, involvement of the venous system (phlebitis/ thrombophlebitis) canlead to complete obstruction of the vessel and venous infarctions, which are often haemorrhagic.

Imaging findings in **stage 5** (cerebral oedema) are primarily related to vasculitis (vasogenicoedema due to blood-brain-barrier changes) but may be complicated by cytotoxic and interstitial oedema. Brain herniation is rare because distensibility of the neonatal cranium. Initially vasogenic oedema occurs secondary to vasculitis and increased permeability of blood vessels.

Complications are subdivided into acute and chronic presentations. **Acute stage complications** include parenchymal gliosis, neuronal loss in the cortex, periventricular leukomalacia (PVL), subdural effusions (sterile: toxin-induced

increased permeability ofcapillaries and veins, resolve spontaneously), brain abscess formation (superimposed infection of ischemic lesions, seen in Citrobacter or Proteus infection). **Chronic changes**included hydrocephalus (often communicating), multicystic encephalomalacia, porencephaly, atrophy, and this may also lead to brain death.

Bacterial cerebritis /brain abscess

Cerebritis represents an early stage of focal purulent brain infection and is relatively uncommon. On MRI, the early cerebritis stage is characterised as an ill-defined area of T2 hyperintensity with patchy enhancement. In the late cerebritis stage, there is an evolutiontowards abscess formation, but still with signs of immaturity. In patients with cerebritis, surgery is contra-indicated (in contradistinction to a brain abscess, which often require surgery).

A brain abscess is an uncommon, but very serious condition. The causative organisms include Citrobacter, Proteus, Pseudomonas, Serratia, Staphylococcus aureus, Streptococcus,Pneumococcus, Candida, Toxoplasma. The MRI appearance varies on the stage of infection. In the early capsule stage, the center of the abscess is hypointense on T1, hyperintense on T2, with an incomplete rim enhancement. In the late capsule stage, the centre of the abscess becomes isointense to CSF, the capsule is hyperintense on T1 and hypointense on T2, with marked and complete rim enhancement. A brain abscess needs to be differentiated from necrotic tumors by clinical history and DWI (pus shows diffusion restriction). MR Spectroscopy may show lactate, lipid, acetate and succinate peaks (due to anaerobe glycolysis in bacteria) and amino acid peaks (due to proteolysis)

Empyema

Empyema is a rare purulent extracerebral collection (mostly as complication of purulent pachymeningitis) and constitutes a neurosurgical emergency! Empyema can be subdural or epidural. Epidural empyema, which is less common, is usually secondary to frontal sinusitis or mastoiditis; it presents a biconvex lentiform shape. Subdural empyema, which is more common, presents a crescentic shape and is commonly seen at the cerebral convexity (after neurosurgery or trauma). Typically, these extracerebral collections display no vasogenic oedema (unless very large or complicated). On DWI, they exhibit reduced diffusion. After administration of a Gd-based contrast agent, they typically reveal peripheral enhancement

CNS tuberculosis

Tuberculous meningitis most commonly manifests as basal leptomeningitis, a thick enhancing exudate which obliterates the basal cisterns, invades the subarachnoid compartment and perivascular spaces. There is often communicating hydrocephalus. Another hallmark of the disease are cerebral infarctions (due to invasion of perivascular spaces and blockage of perforating vessels), mostly seen in the basal ganglia and thalami.

Most children have also parenchymal lesions, which are known as tuberculomas. They occurpredominantly in the supratentorial compartment and are usually smaller than 2 cm in diameter. On contrast-enhanced imaging studies, caseating tuberculous granulomas are identified as ring enhancing lesions, with surrounding edema. Disseminated tuberculosis is characterised by multiple small nodular enhancing lesions with oedema; in a later stage the lesions may calcify. True tuberculous abscess is relatively rare.

Lyme disease (neuroborreliosis)

Lyme disease is caused by the Borrelia (Burgdorferi) bacteria. General symptoms include aflu-like presentation and erythema migrans. Involvement of the CNS, the so-called neuroborreliosis is a rare manifestation of late Lyme disease. The symptoms are relativelynon-specific and include headaches, sleeping disorder, papilloedema, cranial nerve abnormalities.

MR imaging is often negative, though prominent Virchow-robin spaces, hyperintense white matter lesions (MS-like), and meningeal and cranial nerve contrast enhancement are observed in advanced cases. The disease has a milder course in children compared to adults.

FUNGAL INFECTIONS

Fungal infections of the CNS occur if the infection spreads from another part of the body (usually the lungs) to the brain or spinal cord. Fungal infections are uncommon in children,unless in immunosuppressed patients. Fungal meningitis is more frequently encountered than meningoencephalitis or abscess formation. Causative organisms include:

- **Cryptococcus**: meningitis > granuloma
- **Candida**: meningitis, multiple micro-abscesses
- **Aspergillus**: often haemorrhagic abscesses (hypo on T2), ring enhancement
- Histoplasma
- Blastomyces
- Coccidioides

PARASITIC INFECTIONS

Parasitic diseases of the CNS are an important source of morbidity and mortality worldwide and are characterised by a high mortality and morbidity. The infection often leaves survivorswith neurologic sequelae affecting mobility, sensory organs and cognitive functions, as well as seizures or epilepsy. The most common parasitic infections of the CNS include neurocysticercosis, toxoplasmosis, echinococcosis (hydatid disease), Schistosomiasis, Paragonimiasis, Malaria, Toxocariasis.

Neurocysticercosis

Neurocysticercosis typically develops after a human ingests poorly cooked pork with cysts ofthe tapeworm Taenia solium, the larvae develop in the small intestine as an adult tapeworm. The CNS is involved in 60-90 % of patients. The disease has a long incubation period, which implies it is more commonly found in an adult population.

In many countries neurocysticercosis (NCC) is a **frequent cause of seizures and epilepsy**. On imaging parenchymal cysts in the grey matter are found, 5 to 20 mm in diameter. 5-20 mm. The disease occurs in 4 stages: vesicular, colloidal vesicular, granular nodular,nodular calcified. Intraventricular cysts can also occur.

Echinococcosis

Echinococcosis can be caused by Echinococcus granulosus or Echinococcus alveolaris. The disease is characterised by the development of hydatid cysts, predominantly in the liver orthe lungs. CNS involvement is relatively uncommon.

In the brain, echinococcus lesions are mostly diagnosed in adulthood, as (large) cysts, without ring enhancement or oedema. Most commonly they appear as single lesions, butthey can be uni- or bilocular.

TAKE HOME MESSAGES

In CNS infections, clinical presentation and laboratory findings are more important than imaging findings. The most important role for radiologists is to differentiate infectious lesions from other pathology. Specific imaging findings depend on the age group, on thepathogen and are often non-conclusive.

The MRI protocol should include T1 before and after intravenous contrast administration,T2/FLAIR and – importantly – diffusion weighted imaging to identify pus.

Pencitraan pada Tuberkulosis Vertebrae dan Medulla Spinalis (Imaging of Spine and Spinal Cord TB)

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DEFINISI

Spondylitis TB atau penyakit Pott merupakan osteomyelitis dan discitis pada corpus vertebrae yang disebabkan oleh mikrobarium tuberkulosis.

Pada tahun 1779, Sir Percival Pott menggambarkan spondylitis tuberkulosis dan gejala klinis paraplegia pada pasien dengan kelainan bentuk kyphotic pada populasi Eropa.

LATAR BELAKANG

Spondylitis TB biasanya berasal dari sumber infeksi diluar vertebrae dan menyebar secara hematogen. Manifestasi penyakit Pott merupakan kombinasi osteomyelitis dan arthritis, sering kali melibatkan lebih dari satu corpus vertebra. Aspek anterior corpus vertebra yang berdekatan dengan lempeng subkondral biasanya terkena dan dapat menyebar ke diskus intervertebralis yang berdekatan. Pada orang dewasa, lesi diskus merupakan penyakit sekunder akibat penyebaran infeksi dari corpus vertebra. Sedangkan pada anak-anak, diskus dapat menjadi tempat primer karena tervaskularisasi dengan baik.

Destruksi tulang yang progresif menyebabkan kolaps vertebra dan terjadi kyphosis. Canalis spinalis dapat menyempit disebabkan oleh abses, jaringan granulasi, atau invasi ke dural langsung menyebabkan kompresi medulla spinalis dan defisit neurologis. Deformitas kyphotic disebabkan oleh kolaps pada corpus vertebra anterior. Lesi di vertebra thoracal lebih cenderung menyebabkan kyphosis daripada di vertebrae lumbal. Abses dingin dapat terjadi jika infeksi meluas ke ligamentum dan jaringan lunak yang berdekatan. Abses di regio lumbal dapat turun ke bawah selubung psoas ke regio trigonum femoralis dan akhirnya masuk ke dalam kulit.

EPIDEMIOLOGI

Pada 2017 secara global, TB ekstraparu mewakili 14% dari 6,4 juta kasus TB, mulai dari 8% di Wilayah Pasifik Barat WHO hingga 24% di Wilayah Mediterania Timur WHO. Kasus TB tulang belakang merupakan 50% dari infeksi tuberkulosis tulang.

PATOFISIOLOGI

Infeksi TB spinal paling sering ditemui di regio vertebra thoracal bagian bawah atau lumbal atas, meskipun setiap segmen tulang belakang mungkin terlibat. Infeksi TB menyebar secara hematogen baik melalui arteri atau melalui pleksus vena Batson, dengan tempat infeksi utama terjadi di pulmo atau sistem genitourinari. Mirip dengan infeksi piogenik, end plate vertebra anterior biasanya merupakan tempat pertama yang terkena di vertebra, diikuti oleh keterlibatan korpus vertebra bagian sentral. Pola lain dari keterlibatan termasuk dibagian sentral (melalui pleksus vena Batson dengan keterlibatan dominan corpus vertebra), di posterior (melibatkan struktur posterior lebih dominan) dan keterlibatan non-osseous (membentuk abses). Infeksi kemudian menyebar di bawah ligamentum longitudinal dan

dapat menyebabkan infeksi pada corpus vertebra yang berdekatan. Kerusakan vertebra yang progresif menyebabkan deformitas kyphotic dan ketidakstabilan vertebra.

ABSES DINGIN

Abses dingin biasanya tidak memiliki semua tanda inflamasi yang terlihat jelas pada abses. Di vertebra cervical terdapat di ruang retrofaring, segitiga anterior atau posterior cervical atau axilla. Di vertebra thoracal abses terdapat pada pra atau paravertebral; atau di atas dinding dada. Di vertebra lumbal, kemungkinan terdapat di sepanjang otot psoas, segitiga Petit, segitiga Scarpa, atau daerah gluteal.

SUGESTIF SPONDYLITIS TB

Beberapa tanda mengarah ke spondylitis TB adalah: cenderung dimulai di corpus vertebra anterior, tersebar di bawah ligamentum longitudinalis di beberapa corpus vertebrae, keterlibatan seluruh atau beberapa corpus vertebrae, abses paraspinal / psoas ukuran besar, skip lesions dan kalsifikasi paraspinal.

MODALITAS PENCITRAAN

RADIOGRAFI (sensitivitas 15%):

Pada infeksi dini (<30% destruksi vertebral): keterlibatan corpus vertebra anterior dengan sempit ruang diskus. Sedangkan pada infeksi lanjut (>30% destruksi vertebral): destruksi ruang diskus, lusensi dan kompresi corpus vertebra yang berdekatan, dan terjadi kyphosis yang parah. Faktor risiko terjadinya kyphosis vertebra ("vertebral risk signs") apabila terjadi retropulsi, subluksasi, bergeser ke lateral, letak corpus rebah.

CT SCAN (sensitivitas 100%):

Peralatan CT scan dapat membantu dalam menegakkan diagnosis pada tahap yang jauh lebih awal daripada rontgen biasa. Jenis lesi destruktif vertebra dengan pemeriksaan CT adalah: fragmentasi (48,2%); osteolitik (24,1%); subperiosteal dan sklerosis lokal. CT scan juga dapat membantu untuk melakukan biopsi yang dipandu pencitraan.

MRI (Sensitivitas 100% dan spesifisitas 80%)

MRI adalah modalitas yang paling penting dalam diagnosis TB tulang belakang. MRI paling baik mendeteksi pembengkakan jaringan lunak, lokasi abses dan kondisi canalis spinalis. MRI disertai injeksi kontras gadolinium dapat memberikan informasi tambahan mengenai diagnosis. MRI juga dapat menilai respons terhadap pengobatan.

Tipikal pada citra MRI adalah: koleksi sub-ligamentum multi-segmen, terjadinya massa para/pre-vertebral atau abses dengan dinding abses yang relatif menebal, ruang diskus yang relatif lebih sempit hingga tahap akhir penyakit. Peningkatan heterogen setelah injeksi kontras corpus vertebra dapat membantu untuk membedakan spondylodiscitis tuberkulosis dari infeksi piogenik lainnya.

Temuan pada pencitraan MRI terdiri dari: hipointens pada T1WI, hiperintens pada T2WI, adanya abses berdinding halus pra-/ paravertebral / intra-osseous yang bersepta, ekstensi subligamentum melampaui ruang epidural, kerusakan end plate, bayangan jaringan lunak paravertebral, dan intensitas sinyal tinggi di diskus pada T2WI. Pada medulla spinalis dapat memperlihatkan: edema, myelomalacia, atrofi, syringomyeli.

Bentuk perubahan vertebrae dan medulla spinalis pada tuberkulosis berdasarkan pemeriksaan MRI pada prinsipnya sebagai berikut: spondylodiscitis (92%), epidural abscess (81%), paravertebral abscess (81%), spinal cord edema (47%), kolaps corpus vertebra (33.3%).

DIAGNOSIS BANDING

(1). Penyakit metastatis (usia lanjut) yang melibatkan komponen vertebra posterior;

(2). Infeksi piogenik, durasi gejalanya lebih akut seperti nyeri spinal yang parah;

(3). Penyakit degeneratif spinal, umumnya pada pasien usia lanjut.

KESIMPULAN

1. Pencitraan memiliki peran yang sangat penting untuk menegakkan diagnosis tuberkulosis vertebrae dan medulla spinalis.
2. Di antara modalitas pencitraan maka MRI sebagai yang terbaik untuk mendeteksi kerusakan vertebrae, pembengkakan jaringan lunak dan perubahan-perubahan di medulla spinalis.
3. Tanda-tanda spesifik TB vertebra dan medulla spinalis pada pencitraan terdiri dari: kerusakan tulang dan diskus, keterlibatan corpus vertebra anterior, abses pra/paravertebral, skip lesion, lesi corpus vertebra keseluruhan atau multipel, kyphosis, kompresi medula spinalis dan stenosis canalis spinalis.
4. Diagnosis banding: metastasis, spondylitis piogenik dan penyakit degeneratif.

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Neuroimaging of The Spine : Infection or Imitation

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PENDAHULUAN

Infeksi yang melibatkan tulang belakang mewakili sekitar 2-7% dari semua kasus osteomielitis, dan dikategorikan menurut lokasi anatomi proses patologis, infeksi ini dapat mengenai korpus vertebra (spondilitis), diskus intervertebralis (discitis), korpus vertebra dengan diskus intervertebralis (spondylodiscitis), ligamen dan jaringan lunak paravertebral, ruang epidural (abses epidural), meningen dan ruang subarachnoid, dan akhirnya, sangat jarang mengenai sumsum tulang belakang (mielitis, abses sumsum tulang belakang) (Raghavan, Lazzeri and Palestro, 2018). Paling sering terlihat pada orang dewasa yang lebih tua (lebih tua dari 60 tahun), tetapi dapat terjadi pada usia berapa pun. Faktor risikonya termasuk diabetes mellitus, imunosupresi, penggunaan obat IV, malnutrisi, penyakit rematik, dan pembedahan tulang belakang (James D LeClair, 2020). Definisi spondylodiscitis dalam arti sempit berlaku untuk penyakit oleh karena infeksi; namun, ada beberapa kondisi non infeksi yang dapat menyerupai penyakit vertebra infeksi. Perbedaan antara inflamasi/degeneratif versus infeksi patologi memiliki dampak prognostik yang besar (Salaffi *et al.*, 2021). Oleh karena itu, evaluasi yang cepat dari karakterisasi, lokasi dan luasnya penyakit, bersamaan dengan identifikasi etiologi infeksi potensial, sangat penting bagi pasien untuk menghindari pengobatan yang tertunda atau tidak tepat yang dapat mengakibatkan peningkatan morbiditas dan mortalitas (Sundaram and Doshi, 2016)

Modalitas diagnostik yang paling baik yang dapat digunakan untuk mengevaluasi infeksi tulang belakang dan untuk membantu membedakan antara infeksi dan kondisi klinis lainnya adalah Magnetik Resonansi Imaging (MRI). Temuan khas MRI pada kebanyakan kasus infeksi tulang belakang, adalah adanya kerusakan endplate vertebra, kelainan sinyal sumsum tulang dan diskus, dan abses paravertebral atau epidural. Namun, tidak selalu mudah untuk mendiagnosis infeksi tulang belakang, terutama ketika tidak ditemukan beberapa fitur pencitraan MR klasik atau ketika ditemukan pola spondylitis infeksi yang tidak biasa. Beberapa penyakit yang mengenai tulang belakang seperti penyakit inflamasi noninfeksi, penyakit degeneratif dan proses metastase dapat menyerupai gambaran infeksi tulang belakang. (Sung Hwan Hong*, et al,* 2009). Potongan sagital harus dilengkapi dengan bidang aksial untuk visualisasi dan penggambaran phlegmon atau abses yang lebih baik. Saturasi lemak T1WI setelah pemberian agen kontras juga digunakan untuk mendeteksi abses. DWI telah digunakan baru-baru ini terutama untuk membedakan antara spondylodiscitis dan gangguan degeneratif serta keterlibatan tumor tulang belakang (Boudabbous *et al.*, 2021).

Infeksi Tulang Belakang

Infeksi tulang belakang dapat diklasifikasikan ke dalam diskitis, abses tulang belakang, dan spondilitis dan biasanya merupakan hasil dari penyebaran hematogen. Pengobatan pada infeksi tulang belakang yang dilakukan dengan segera akan memberikan prognosis yang baik, tetapi keterlambatan diagnostik sangat terkait dengan komplikasi seperti defisit neurologis permanen (Chen et al., 2020).

Spondylodiscitis merupakan penyakit kompleks yang memberikan tantangan dalam hal diagnosisnya. Definisi spondylodiscitis dalam arti sempit berlaku untuk penyakit infeksi, baik yang pyogenik maupun non piogenik(Salaffi *et al.*, 2021). Infeksi tulang belakang pyogenik paling sering disebabkan oleh Staphylococcus aureus (pada > 50% pasien) dan spesies Enterobacter (pada 30% pasien). Mycobacterium tuberculosis menyebabkan sebagian besar infeksi tulang belakang nonpiogenik; namun, jamur (misalnya, spesies Cryptococcus, spesies Aspergillus, coccidioidomycosis) juga dapat menyebabkan infeksi (James D LeClair, 2020).

Karena mempunyai sensitivitas dan spesifisitas yang tinggi (sensitivitas 96% dan spesifisitas 92%), MRI merupakan pencitraan penting dan memainkan peran kunci dalam diagnosis banding kelainan pada tulang belakang dengan menilai karakteristik lesi. MRI memberikan informasi anatomi rinci, terutama mengenai ruang epidural dan sumsum tulang belakang. Beberapa kelainan tulang belakang degeneratif lainnya dan penyakit metastasis pada tulang belakang, mengakibatkan tantangan diagnostik yang kompleks. Selain itu, karena penyebaran infeksi piogenik secara hematogen dari tempat lain, biasanya gejala dan tanda pada tulang belakang dapat ditutupi oleh manifestasi dari infeksi primer. Akibatnya, infeksi tulang belakang sering didiagnosis 1-2 bulan setelah timbulnya gejala (Ahn et al., 2020)

Selama tahap akut, MRI dapat menunjukkan peningkatan intensitas sinyal pada T2WI di korpus vertebra atau ruang diskus yang disebabkan oleh infark, abses, atau edema. Pada T1WI, penurunan intensitas sinyal dapat diamati pada disk dan endplate yang berdekatan sebagai akibat dari edema, dan margin antara disk dan endplate dapat berkurang. Sekuen Fat supresi pada T1WI dengan kontras harus dilakukan secara rutin. Abses paraspinal dan epidural umumnya tampak isointens dengan otot pada T1WI dan hiperintens pada T2fat saturasi atau short-tau inversion recovery (STIR). Abses korpus vertebra mungkin tampak lebih mencolok pada gambar dengan difusi weighted (DWI) dibandingkan T1WI atau T2WI konvensional. Pada MRI dengan kontras, abses epidural menunjukkan penyangatan perifer di sekitar area dengan intensitas sinyal cairan; atau sebagai area penyangatan abnormal diskus, sumsum tulang belakang, atau jaringan lunak paraspinal (James D LeClair, 2020)

Konteks Klinis

Spondilitis memberikan kontribusi 2%-4% dari semua kasus infeksi tulang (osteomyelitis). Cara penyebaran terjadinya infeksi tulang belakang dapat melalui jalur hematogen dari fokus septik yang jauh, perluasan langsung dari fokus septik di jaringan lunak yang berdekatan ataupun melalui inokulasi langsung dari operasi tulang belakang atau trauma tembus. Predileksi infeksi pada tulang belakang biasanya terjadi di bagian anterior korpus vertebra karena suplai arterinya yang kaya dan kemudian menyebar ke seluruh korpus vertebra di sepanjang ruang meduler. Kuman patogen yang ditularkan secara hematogen dapat mencapai tulang belakang baik dengan aliran antegrade melalui arteriol nutrisi dari badan vertebral atau dengan aliran retrograde melalui pleksus vena Batson paravertebral. Selanjutnya infeksi akan menyebar ke vertebra yang berdekatan melalui ruang diskus, yang biasanya terlibat dalam infeksi piogenik. 50% kasus berada pada daerah lumbal, diikuti tulang belakang di daerah dada (35% kasus) dan tulang belakang leher (Hwan Hong, et al, 2009)

Anatomi vaskular corpus vertebra

Untuk memahami pola khas infeksi pada tulang belakang, penting dalam memahami anatomi jaringan vascular corpus vertebra dewasa. Suplai arteri ke setiap corpus vertebra terdiri dari pasangan arteri segmental yang muncul, tergantung pada lokasinya, dari arteri vertebralis, aorta, atau arteri iliaka. Arteri segmental berjalan di bidang ekuator di sekitar corpus vertebra masing-masing, dan sepanjang jalurnya menuju proses transversal, dan mengeluarkan beberapa saluran anastomosis ekstraosseus. Di dalam korpus vertebra, dari setiap arteri segmental terdapat sepasang arteri metafisis dan arteri nutrisi tunggal, yang keduanya memiliki pembuluh akhir pada endplate superior dan inferior dari setiap korpus vertebra. Arteri metafisis juga mensuplai jaringan arteri anastomosis intermetafisis yang mencakup beberapa tingkat corpus vertebra. Pada masa kanak-kanak, jaringan arteri ini meluas ke tingkat diskus intervertebralis dan menyediakan jaringan kapiler yang kaya yang dianggap sebagai pembuluh akhir dan biasanya merupakan lokasi akhir untuk emboli septik. Namun, pada orang dewasa, jaringan kapiler yang kaya mengalami regresi dan pembuluh darah akhir arteri berakhir di endplate superior dan inferior corpus vertebra, menghasilkan lokasi awal yang berbeda untuk infeksi tulang belakang dibandingkan dengan usis anak. Saluran anastomosis ekstraosseous dan intermetafase multipel menyiratkan bahwa infeksi dapat menjangkau beberapa corpus vertebra dan kadang-kadang mengenai corpus vertebra yang tidak bersebelahan. Selain itu, avaskularitas diskus intervertebralis dewasa menunjukkan bahwa bagian tulang belakang ini akan terlibat dalam infeksi pada stadium

kronis atau lanjut, dan hanya pada organisme dengan aktivitas proteolitik yang sesuai untuk mendapatkan akses ke ruang diskus (Sundaram and Doshi, 2016).

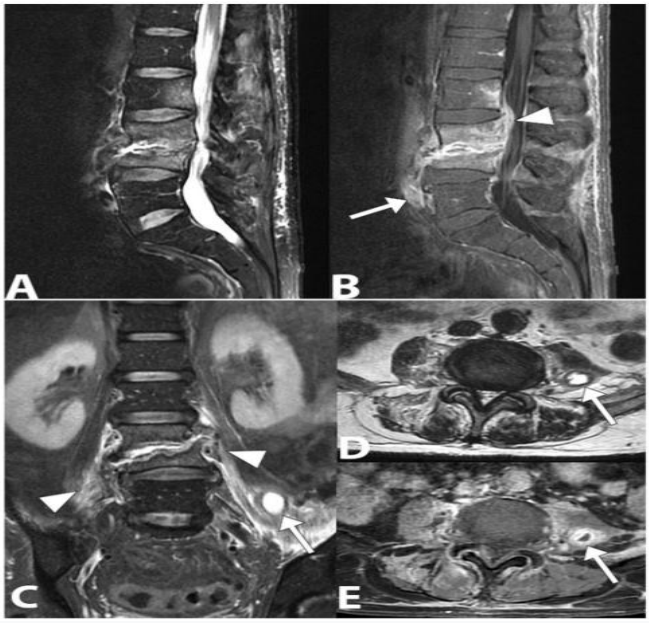
Suplai vena juga dapat menyediakan saluran untuk infeksi potensial. Vena yang lebih sedikit katup keluar dari korpus vertebra di foramen nutrisi dorsal dan bermuara ke pleksus vena ekstradural yang selanjutnya mengalir ke pleksus vena paravertebralis Barton. Rute vena memungkinkan penyebaran infeksi secara retrograde dari organ perut dan panggul, seperti pada infeksi saluran kemih. Ini juga cenderung menjadi rute infeksi jamur dan tuberkulosis yang disukai (Sundaram and Doshi, 2016).

Spondilitis piogenik

Sebanyak 48-70% Spondilodiscitis tulang belakang disebabkan oleh kuman Streptococcus, sisanya dapat disebabkan oleh kuman negative dan positif (Sundaram and Doshi, 2016). Berdasarkan anatomi arteri dewasa yang khas, spondylodiscitis piogenik hematogen sering pertama kali mempengaruhi daerah subkondral dari endplates corpus vertebral, dan menyebar ke arah anterior ke posterior. Seiring waktu, bakteri dengan sifat yang lebih virulen dan proteolitik, seperti S. aureus, menyebabkan kerusakan kortikal dan menginvasi melampaui endplate dan ke dalam diskus intervertebralis. Mereka juga dapat menyebar di sepanjang jaringan anastomosis arteri ke beberapa korpus vertebral yang terkadang tidak bersebelahan, atau ke dalam ruang epidural (Sung Hwan Hong, et al, 2009).

Spondilitis piogenik paling sering melibatkan tulang belakang lumbal dan satu segmen tulang belakang, yang terdiri dari dua corpus vertebra dan diskus. Biasanya menunjukkan intensitas sinyal rendah pada T1WI, dengan hilangnya definisi end plate vertebral dan corpus vertebra yang berdekatan, dan intensitas sinyal tinggi pada T2WI. Pada ruang diskus yang terlibat, tampak intensitas sinyal seperti cairan pada T1WI dan T2WI. Setelah pemberian kontras berbasis gadolinium secara intravena, tampak pola penyangatan sebagian besar diskus yang homogen, sebagian lagi menunjukkan penyangatan yang heterogen, serta tampak pula penyangatan tebal atau tipis pada area perifer. Sumsum tulang yang terinfeksi juga menunjukkan penyangatan kontras yang difus. Penyangatan kontras pada Fat suppresi sangat berguna dalam menunjukkan kelainan pada sumsum tulang belakang. Perluasan ke paravertebral dan epidural dapat muncul dalam bentuk phlegmon atau abses dan menunjukkan intensitas sinyal campuran baik pada T1WI maupun T2WI. Namun, biasanya tampak isointense atau hipointens relatif terhadap sumsum tulang belakang pada T1WI dan hiperintens pada T2WI (Raghavan, Lazzeri and Palestro, 2018)

Karena konsentrasi tinggi enzim proteolitik intrinsik terhadap virulensi agen biologis, keterlibatan diskus terjadi pada awal perjalanan penyakit dan dapat ditunjukkan bersamaan dengan lesi korpus vertebra yang sesuai pada tahap awal penyakit. infeksi. Keterlibatan korpus vertebra cenderung lebih homogen dalam kaitannya dengan perubahan intensitas sinyal pada T1WI dan T2WI disertai penyangatan ruang medulernya (de Souza *et al.*, 2013).



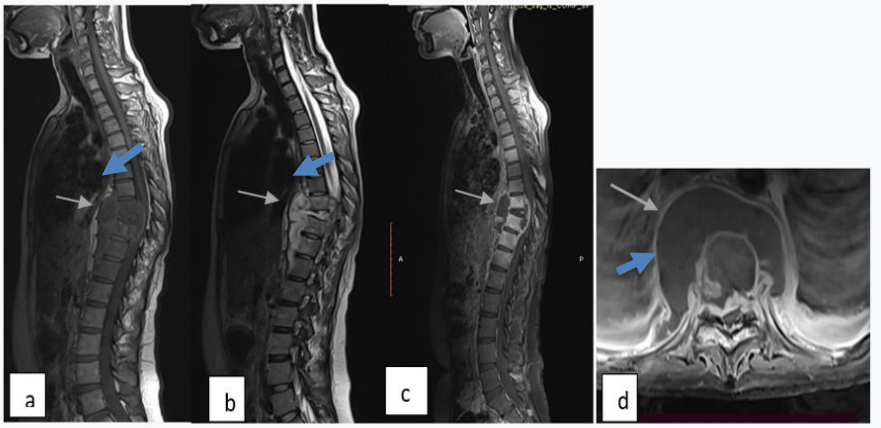
Gbr 1. Spondilodiscitis Gram-negatif (Escherichia coli). Gambar MRI tulang belakang lumbal sagital (a) menunjukkan sinyal sumsum tulang yang tinggi dan kolaps sebagian dari corpus vertebra L3 dan L4, destruksi diskus L3–L4 dan irregularitas end plate di kedua sisi diskus. Pada gambar sagittal T1WI diperoleh dengan saturasi lemak dan setelah injeksi media kontras (b), gambaran yang lebih baik dari keterlibatan paravertebral (panah) dan ruang epidural dengan penyempitan kanal vertebral (panah) dapat diamati. Korpus vertebra L2 posterior juga terlibat. Pada coronal pada STIR (c), axial T2WI (d) dan axial T1WI dengan saturasi lemak dan gadolinium (e), edema dan eksudat inflamasi dapat diamati pada jaringan lunak paravertebral (panah) dan abses di otot psoas kiri (panah) (Salaffi *et al.*, 2021).

Pencitraan MR Diffusion Weighted Image (DWI) tidak hanya membantu untuk mengevaluasi perluasan spondilodisitis piogenik, tetapi juga dapat membantu membedakannya dari patologi potensial lainnya. Fokus infeksi bakteri biasanya memiliki intensitas sinyal yang tinggi pada DW-MRI, dan menunjukkan sinyal rendah pada pemetaan ADC, yang menunjukkan adanya pembatasan difusi. Diperkirakan bahwa selularitas yang tinggi dan adanya nanah berkontribusi pada pembatasan difusi dalam proses infeksi. Efusi steril dan CSF normal biasanya tidak menunjukkan nilai restriksi difusi yang rendah seperti pada spondilodisitis piogenik (Sundaram and Doshi, 2016).

Spondilitis Tuberkulosis

Infeksi tulang belakang yang disebabkan oleh kuman tuberkulosis paling sering melibatkan tulang belakang dada dan lebih jarang tulang belakang lumbal. Seringkali sulit untuk membedakan antara tuberkulosis dan spondilitis piogenik, baik secara klinis maupun pada gambar. Dalam kebanyakan kasus, spondilitis tuberkulosis dimulai di tulang belakang anterior dan jaringan lunak dan berkembang ke posterior. Dapat melibatkan 3 vertebra yang berdekatan atau tidak berdekatan, yang bukan merupakan temuan khas pada metastasis tulang belakang atau piogenik spondilodisitis Diskus intervertebralis jarang terlibat yang disebabkan oleh kurangnya enzim proteolitik pada infeksi Mycobacteria dibandingkan dengan infeksi piogenik, dan merupakan penyebab relatif terjaganya diskus intervertebralis. Jika tidak terlibat, diskus tidak akan meningkatkan sinyal pada gambar T2WI (Smith et al., 1989) Secara klasik, tuberkulosis tulang belakang diperkirakan dimulai di bagian anteroinferior corpus vertebra. Penyebaran infeksi dapat terjadi di bawah ligamen longitudinal yang melibatkan korpus vertebra yang berdekatan. Penyempitan ruang diskus terjadi secara sekunder dan oleh karena itu biasanya terbatas relatif terhadap derajat destruksi tulang. Penghancuran tulang memungkinkan herniasi bahan diskus ke dalam korpus tubuh yang terkena. Adanya abses dengan dinding yang tipis dan halus di daerah paraspinal; penyebaran subligamentous ke tiga atau lebih tingkat vertebra; dan keterlibatan

multiple vertebra atau seluruh corpus vertebra, diskus yang relatif terhindar pada fase awal penyakit; dan peningkatan/perubahan heterogen dalam sinyal korpus vertebra merupakan temuan yang lebih mengarah pada spondilitis tuberkulosa daripada spondilitis piogenik. Terdapat juga lesi skip dan abses dingin paraspinal yang besar. Pada fase awal penyakit, diagnosis banding dengan misalnya, neoplastik, proses degeneratif atau inflamasi mungkin sulit dibuat. Dalam kasus seperti itu, kriteria morfologi, adanya sinyal dari daerah yang terkena dampak pada T2WI, dan karakteristik penyangatan gadolinium mungkin berguna untuk membantu diagnosis (de Souza *et al.*, 2013).



Gbr 2. Spondilitis tuberculosis pada perempuan berusia 25 tahun. (a)MR sagital T1WI menunjukkan penurunan intensitas sinyal dari sumsum tulang korpus vertebra Th 9 dan 10 (panah biru) dan lesi di paravertebral (panah putih) (b) MR Sagittal T2WI menunjukkan peningkatan intensitas sinyal pada korpus Th 9,10 (panah biru) serta pada lesi paravertebral (panah putih). (c) MR sagittal T1WI dengan kontras axial T1WI dengan kontras menunjukkan rim like abses jaringan lunak paravertebral (panah) (d) MR axial pada T1WI dengan kontras menunjukkan penyangatan rim like abses paravertebral (panah putih) dan di epidural (panah biru).

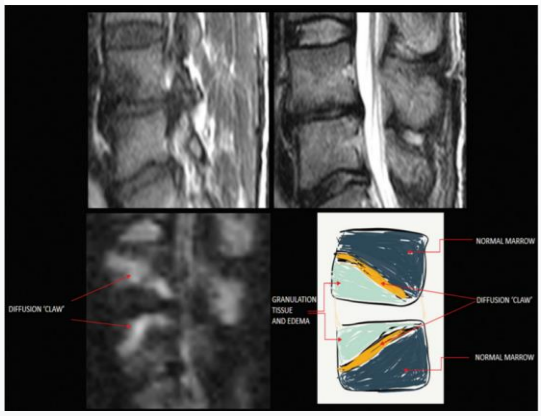
Gangguan yang Menyerupai Infeksi Tulang Belakang

1. Perubahan Degeneratif Modic 1 dari end plate

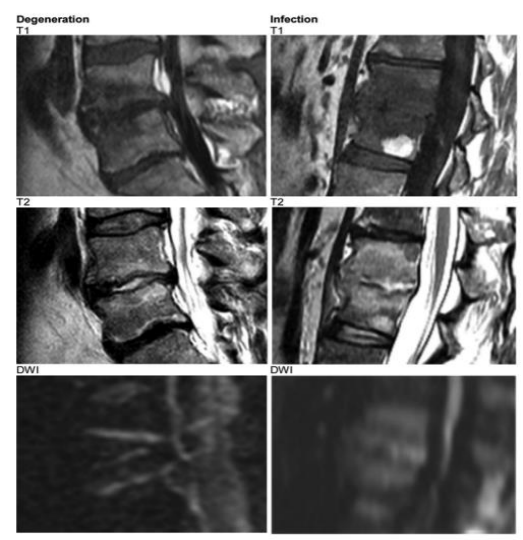
Degenerasi tipe 1 modic dapat menyerupai spondilitis infeksiosa karena adanya edema sumsum tulang, yang memiliki intensitas sinyal tinggi pada T2WI. Perubahan sumsum tulang ini juga dapat muncul sebagai area yang menyangat kontras. Kurangnya intensitas sinyal yang meningkat secara tidak normal dari diskus terkait pada T2WI dan kurangnya keterlibatan jaringan lunak adalah temuan karakteristik dari degenerasi tipe 1 Modic (Sung Hwan Hong, *et al*, 2009)). Edema sumsum tulang pada lesi modic type 1 terbatas pada daerah subkondral, ujung end plate tulang belakang tetap terdefinisi dengan baik dan diskus yang mengalami degenerasi memiliki intensitas sinyal yang rendah daripada peningkatan sinyal yang terlihat pada infeksi tulang belakang pada T2WI (Raghavan, Lazzeri and Palestro, 2018). End plate dapat menunjukkan penyangatan kontras pada perubahan degenrative dan infeksi. Terdapat pula respon inflamasi dari anulus fibrosus yang ditandai dengan neovaskularisasi di sekitar annulus pulposus yang mengalami exkstrusi pada herniasi. Degenerasi intervertebral dari diskus ditandai dengan dehidrasi bertahap dari diskus itu sendiri dan muncul pada MRI sebagai hilangnya hiperintensitas normal dari nucleus pulposus pada T2WI disertai dengan hilangnya tinggi diskus. Namun, diskus yang mengalami degenerasi hebat dapat menunjukkan hiperintensitas sinyal T2. (Salaffi et al., 2021).

Pada sequence DWI pada MRI, terdapat pola kelainan difusi yang berbeda, berupa claw sign, yang berguna dan akurat untuk membedakan degenerative spondylosis dari diskitis/osteomielitis pada pasien dengan perubahan endplate Modic tipe 1. Pada tingkat yang mencurigakan, yang pasti claw sign difusi menandakan kemungkinan penyakit degeneratif yang sangat tinggi (97%-100%) daripada infeksi. Kemungkinan *claw sign* sangat sugestif dari

penyakit diskus degeneratif (85% -100%) daripada infeksi. Sebaliknya, pola sinyal difusi yang meningkat secara difus (*claw sign* negatif) menandakan infeksi pada 93%–100% pasien, daripada degenerasi disk dengan perubahan end plate Modic type 1. Penggunaan tanda *claw sign* dalam praktik sehari-hari dapat mengurangi biaya dengan menghilangkan atau mengurangi kekhawatiran akan infeksi pada pasien bergejala yang bermanifestasi sebagai perubuahan Modic tipe 1, yang mungkin memicu tindakan invasif dan penggunaan kontras sebagai pemeriksaan tindak lanjut (Patel *et al.*, 2014).



Gbr 3. *Claw sign* diidentifikasi pada DWI sebagai daerah sinyal tinggi berbatas tegas, linier, biasanya berpasangan, yang terletak di dalam korpus vertebral yang berdampingan pada batas antara sumsum tulang normal dan sumsum tulang yang tervaskularisasi (Patel *et al.*, 2014)

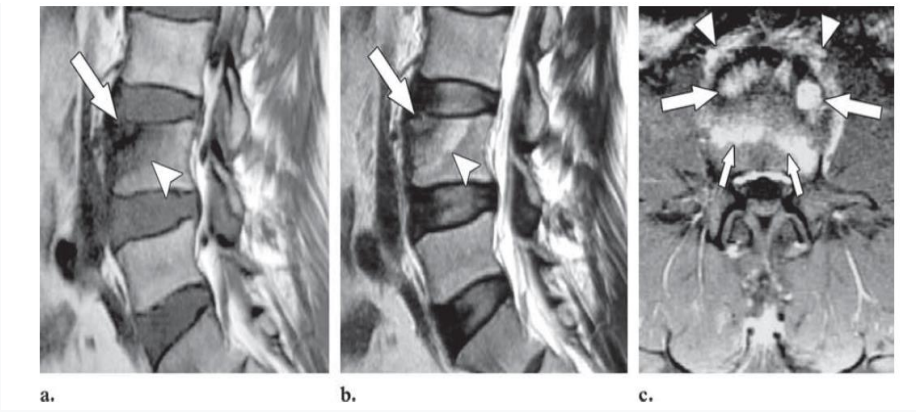


Gbr 4. Kedua kasus menunjukkan sinyal T2 tinggi pada disk yang terpengaruh. *Claw sign* berhasil membedakan degenerasi diskus dari infeksi diskus (Patel *et al.*, 2014).

2. Nodus Kartilaginosa Akut

Pada pencitraan rutin, adanya nodus kartilaginosa traumatis akut jauh lebih jarang diidentifikasi dibandinglkan kondisi kronis tanpa gejala. Edema sumsum tulang belakang yang mengelilingi nodus kartilaginosa yang nyeri pada gambar MR diduga berkorelasi dengan ekstrusi diskus ke dalam endplate. Tergantung pada luas dan polanya, tanda khas nodus kartilaginosa akut, mungkin tidak dapat dibedakan dari spondilitis infeksiosa. Reaksi

sumsum tulang, edema, dan peningkatan kontras dapat disebabkan oleh vaskularisasi dan inflamasi nodus tulang rawan. Pada T2WI, kehadiran konsentris intensitas sinyal tinggi cincin yang mengelilingi nodus kartilaginosa dapat membantu membedakan nodus edematous dari spondilitis infeksiosa, di mana sumsum tulang yang berdekatan biasanya menunjukkan pola edema yang menyebar dengan batas yang tidak jelas khas dari edema kronis. Selain itu, ketika defek tulang hanya melibatkan satu endplate dan diskus tidak menunjukkan kelainan sinyal difus, nodus kartilaginosa akut harus dicurigai. (Sung Hwan Hong, *et al*, 2009)



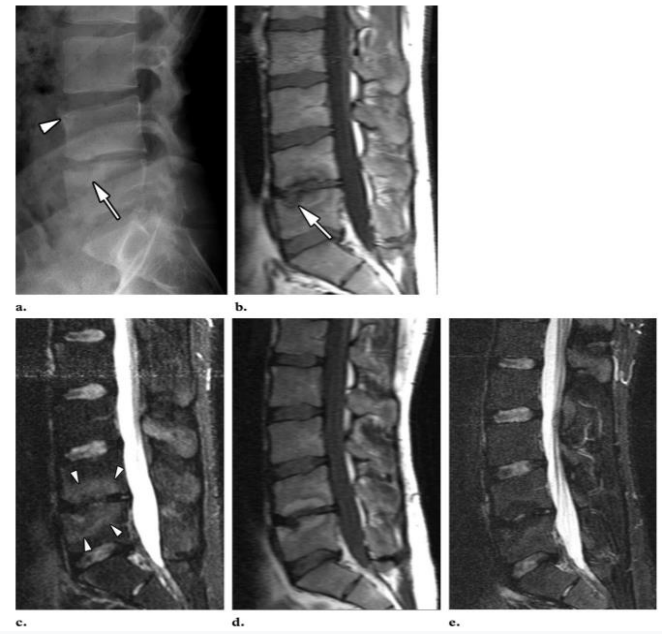
Gbr 5 . Nodus kartilaginosa akut pada pria berusia 55 tahun. (a, b) Sagittal T1WI (a) dan T2WI (b) Gambar MR menunjukkan defek endplate (panah) dan perubahan seperti edema di sekitar sumsum tulang (panah) di korpus vertebra L4. Tidak ada kelainan sinyal yang signifikan terlihat pada disk L3-4 dan korpus L3. (c) Gambar MR Axial T1WI fat saturasi dengan kontras menunjukkan defek ujung end plate anterior multipel (panah besar) dengan peningkatan yang kuat dari korpus vertebra (panah kecil) dan jaringan lunak paravertebral anterior (panah) (Sung Hwan Hong, *et al,* 2009)

3. Axial Spondiloartritis

Axial Spondyloarthritis (axSpA) adalah gangguan inflamasi kronis yang terutama melibatkan kerangka aksial. Temuan pencitraan axSpA dapat dibagi menjadi perubahan aktif, yang meliputi edema sumsum tulang, sinovitis, entesitis, capsulitis, dan efusi intra-artikular, dan perubahan struktural, yang meliputi erosi, sklerosis, infiltrasi lemak tulang, deposisi lemak di rongga erosi, dan jembatan tulang atau ankilosis (Caetano, Mascarenhas and Machado, 2021). Pencitraan tulang belakang yang direkomendasikan termasuk T1WI, untuk menilai morfologi struktur, T2WI atau short tau inversi recovery (STIR) untuk mendeteksi bone marrow edema, dan T1fatsat dengan gadolinium untuk menunjukkan inflamasi jaringan (entesitis dan sinovitis). Secara khas, lesi inflamasi pada tulang belakang vertebral muncul di beberapa area. Biasanya, lesi inflamasi axSpA ditemukan di sudut vertebra anterior (lesi Romanus), di tingkat pusat, di segmen tulang belakang lateral dan posterior seperti pedikel, costotransverse, costovertebral, dan sendi zigoapophyseal. Lesi kemudian dapat cenderung ke arah evolusi erosif di bagian anterior korpus vertebra torakolumbalis dan selanjutnya, erosi dikaitkan dengan perubahan sklerotik dan syndesmophytes yang pada penyakit jangka panjang, cenderung menyatu. Kadang-kadang, axSpA disertai dengan perubahan fokal erosif pada endplate terminal vertebra, disebut sebagai lesi Andersson. Perubahan ini sulit untuk dibedakan dari spondylodiskitis infeksi (Salaffi *et al.*, 2021).

Dalam MRI, selama perkembangan spondylodiscitis, diskus sering menjadi titik fokus untuk pengumpulan cairan. Namun, dalam axSpA, diskus biasanya mempertahankan intensitas sinyal regulernya atau hanya menunjukkan tanda-tanda degenerasi. Oleh karena itu, pada axSpA, variasi intensitas sinyal cenderung terbatas di dalam korpus vertebra dan ujung endplate vertebra, tetapi tidak pada diskus. Selanjutnya, efusi perivertebral dan efusi intradiskus jarang terlihat pada lesi diskovertebral di axSpA. Intensitas sinyal yang tinggi pada gambar T2WI yang

diamati pada lesi Andersson biasanya berhubungan dengan jaringan granulasi, dan area perifer T2 dengan intensitas tinggi mencerminkan infiltrasi jaringan dan sel inflamasi, bukan pengumpulan cairan. Kurangnya pengumpulan cairan intradiscal atau perivertebral merupakan tanda diagnostik yang penting (Salaffi et al., 2021).

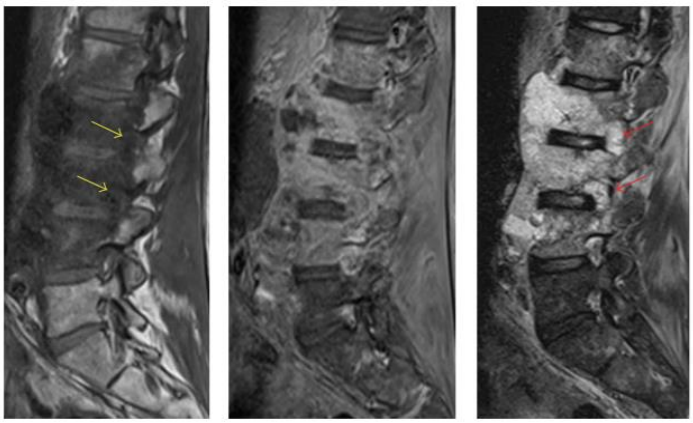


Gbr.6 Spondylodiskitis (lesi Andersson inflamasi) pada pasien 24 tahun dengan ankylosing spondylitis. (a) Radiografi lateral tulang belakang lumbar menunjukkan pengurangan tinggi ruang diskus intervertebralis, sklerosis pada endplate di L4 –5, erosi (panah) dari endplate superior L5 (lesi Anderson), dan syndesmophyte di L4 (panah). (b) fast spin-echo T1WI sagital menunjukkan defek erosif pada endplate inferior (panah) L4 dan endplate superior L5, serta hilangnya sinyal di sumsum tulang sekitarnya. (c) Gambar STIR menunjukkan peningkatan intensitas sinyal (panah) yang berdekatan dengan diskus intervertebralis (lesi Andersson florid). (d) T1WI sagital yang diperoleh 26 minggu setelah pengobatan dengan inhibitor TNF menunjukkan peningkatan intensitas sinyal dalam bekas daerah dengan intensitas sinyal rendah, temuan yang menunjukkan degenerasi sumsum tulang lemak pasca inflamasi. (e) Gambar STIR menunjukkan regresi lengkap dari perubahan intensitas sinyal tinggi sebelumnya (Hermann *et al.*, 2005)

4. Proses metastase tulang belakang

Tulang belakang adalah salah satu tempat yang paling umum dari metastasis di banyak kanker seperti kanker payudara, prostat, tiroid, dan paru-paru. Sekitar 60-70% pasien dengan keganasan memiliki metastasis tulang belakang. (Charoen, 2010). Biasanya, lesi litik neoplastik dengan metastasis ke kerangka aksial tidak terkait dengan sklerosis reaktif atau reaksi periosteal dan biasanya, tempat pertama yang terkena adalah pedikel vertebral. Pada MRI, metastasis tulang belakang menunjukkan destruksi korpus vertebra difus, intensitas sinyal rendah pada T1WI, dan intensitas sinyal iso atau tinggi pada T2WI pada sumsum tulang korpus vertebra yang tidak berdekatan. Ketinggian korpus vertebra yang terlibat biasanya menurun. Namun, diskus intervertebralis dan ruang diskus relatif terpelihara, dan phlegmon atau abses jaringan lunak paraspinal jarang terjadi. Fraktur patologis korpus vertebra dapat terjadi bila pertumbuhan tumor menginvasi tulang vertebra. Fraktur patologis ditandai dengan kompresi dan deformasi dari tubuh vertebral yang terlibat untuk derajat yang bervariasi, yang dapat menonjol ke empat sisi dan menyebabkan kyphosis yang jelas. Fraktur baji terbalik disebabkan oleh suplai darah yang melimpah dari posterior seperempat atas tubuh vertebral, yang juga merupakan tempat metastasis awal. (Chen and Lu, 2021).

Di sisi lain, MRI spondylodiscitis infeksi menunjukkan infiltrasi sumsum tulang di segmen tulang belakang yang berdekatan dengan intensitas sinyal rendah pada T1WI dan intensitas sinyal tinggi pada T2WI dari korpus vertebra dan end plate. Penghancuran korpus vertebra dan endplate tidak begitu menonjol seperti pada metastasis tulang belakang, dan hanya diskontinuitas kortikal dari endplate yang mungkin terlihat. (Lee, Lee and Bae, 2015).



Gbr 7. MR dengan T1WI sagital (a) menunjukkan hipointensitas abnormal yang berhubungan dengan invasi oleh massa paraspinal (sarkoma sel spindel). Margin kortikal pedikel dilemahkan (panah kuning) sesuai dengan perubahan erosif massa yang menyerang melalui foramen neuralis ke dalam ruang epidural lateral. T1WI pasca kontras dengan saturasi lemak (b) menunjukkan peningkatan yang heterogeny dari massa. Infiltrasi sumsum tulang dan keterlibatan neuroforaminal (panah merah) terlihat jelas sebagai sinyal hiperintens pada STIR (c) (Shah and Salzman, 2011)

KESIMPULAN

Konfirmasi dan lokalisasi infeksi tulang belakang biasanya tergantung pada temuan pencitraan. Pencitraan resonansi magnetik (MR) lebih disukai karena sensitivitas dan spesifisitasnya yang tinggi. Bukti keterlibatan dua vertebra berturut-turut dan diskus intervetebral hampir mendiagnosa spondilitis infeksiosa. Infeksi tulang belakang biasanya menunjukkan intensitas sinyal yang khas pada T1WI dan T2WI dan penyangatan kontras dalam sumsum tulang yang terkena setelah pemberian bahan kontras berbasis gadolinium. Namun, kelainan sumsum dan pola penyangatan mungkin tidak spesifik, terutama pada fase awal infeksi. Lebih lanjut, banyak proses penyakit yang berbeda dapat menyerupai spondilitis infeksiosa. Dalam kebanyakan kasus, menggunakan pola pencitraan MR untuk mengenali penyakit dapat membantu membedakan spondylitis dari kondisi lain. Spesifisitas pencitraan MR tergantung pada karakteristik sinyal dan distribusi anatomis infeksi dan riwayat klinis pasien (Sung Hwan Hong, et al, 2009). T2WI adalah kunci untuk diagnosis penyakit diskus intervertebralis. Sebagian besar infeksi ruang diskus menunjukkan peningkatan intensitas signal pada T2WI, sedangkan perubahan degeneratif menunjukkan penurunan intensitas signal. Adanya penyangatan diskus setelah pemberian gadolinium membuat deteksi diskus yang terinfeksi lebih mudah. Kesadaran temuan pencitraan MR atipikal dari spondilitis infeksi awal penting untuk menghindari keterlambatan diagnostik dan prosedur diagnostik yang tidak perlu (Charoen, 2010).

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Peranan Transcranial Doppler untuk Mengevaluasi Meningitis Tuberkulosis

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ABSTRAK

Meningitis tuberkulosis adalah suatu peradangan pada lapisan meningens otak termasuk duramater, arachnoid, dan piamater yang dapat terjadi pada anak anak maupun dewasa. Meningitis tuberkulosis disebabkan oleh bakteri *Mycobacterium tuberculosis* dimana bakteri tahan asam ini masuk ke dalam tubuh manusia melalui droplet inhalasi. Infeksi lokal di paru menjadi luas dan menyebar secara hematogen ke ekstraparu termasuk sistem saraf pusat (SSP). Insidensi meningitis tuberculosis di dunia, Asia Tenggara maupun di Indonesia cukup banyak sehingga diperlukan diagnosis dan penatalaksanaan yang tepat.

Komplikasi vaskular merupakan penyebab penting infark serebral pada meningitis tuberkulosis. Ultrasonografi Doppler Transcranial (TCD) adalah alat non-invasif yang dapat memberikan informasi real-time tentang hemodinamik serebral. Namun, literatur tentang peran TCD dalam diagnosis atau pemantauan vaskulopati yang terkait dengan meningitis tuberkulosis masih jarang. Kami mengeksplorasi peran TCD dalam diagnosis dan pemantauan vaskulopati terkait meningitis tuberkulosis pada arteri intrakranial utama.

ABSTRACT

Tuberculous meningitis is an inflammation of the meninges lining the brain including the dura mater, arachnoid, and pia mater that can occur in children and adults. Tuberculous meningitis is caused by the bacterium Mycobacterium tuberculosis where these acid-fast bacteria enter the human body through inhalation droplets. Local infection in the lung becomes widespread and spreads hematogenously to the extrapulmonary tract including the central nervous system (CNS). The incidence of tuberculous meningitis in the world, Southeast Asia and Indonesia is quite high, so proper diagnosis and management is needed.

Vascular complications are an important cause of cerebral infarction in tuberculous meningitis. Transcranial Doppler Ultrasonography (TCD) is a non-invasive tool that can provide real-time information on cerebral hemodynamics. However, literature on the role of TCD in the diagnosis or monitoring of vasculopathy associated with meningitis tuberculosis is scarce. We explored the role of TCD in the diagnosis and monitoring of TBM-associated vasculopathy of the major intracranial arteries.

PENDAHULUAN

Meningitis adalah suatu reaksi peradangan yang terjadi pada lapisan selaput yang membungkus jaringan otak (arakhnoid, piamater) dan sumsum tulang belakang yang disebut meningen. Penyakit ini merupakan penyakit yang paling sering ditemukan di negara yang sedang berkembang, salah satunya adalah Indonesia.[1] Meningitis tuberkulosis adalah peradangan selaput otak atau meningen yang disebabkan oleh bakteri *Mycobacterium tuberculosis*. Meningitis tuberkulosis merupakan hasil dari penyebaran hematogen dan limfogen bakteri *Mycobacterium tuberculosis* dari infeksi primer pada paru. [2]

Kasus tuberkulosis ekstraparu di Indonesia adalah sejumlah 6,05% dari total kasus tuberculosis yang tercatat. Suatu studi epidemiologi tuberkulosis ekstraparu di Amerika Serikat menunjukkan bahwa 5–10% dari total kasus [1] ekstraparu merupakan meningitis tuberkulosis. CDC (*Centers for disease control and prevention*) tahun 2005 menunjukkan persentase meningitis tuberkulosis sebesar 6,3% dari kasus tuberkulosis ekstraparu (1–3% dari keseluruhan kasus tuberkulosis). [3]

Transcranial Doppler (TCD) diperkenalkan pada awal 1980-an untuk mengevaluasi kecepatan aliran darah arteri intracranial. [3]. Sejak itu banyak aplikasi lain dari transcranial doppler telah dipergunakan untuk penilaian status hemodinamik dari sirkulasi serebral, pemantauan secara *real-time* proses rekanalisasi selama pengobatan reperfusi stroke akut, konfirmasi kematian otak, deteksi perubahan ekogenik pada basal ganglia pada pasien dengan penyakit neurodegeneratif tertentu, sonotrombolisis pada stroke iskemik , kegunaan potensial dalam diagnosis demensia vaskular, penilaian kapasitas cadangan serebrovaskular pada pasien dengan penyakit arteri karotis, dan deteksi pirau kanan ke kiri. [4-5]

Meningitis Tuberkulosis

Tuberkulosis merupakan penyebab utama morbiditas dan mortalitas. [5]. Ini dapat melibatkan sistem saraf pusat sebagai infeksi primer atau sekunder dari meninges (meningitis tuberkulosis) atau parenkim otak. [5,6]

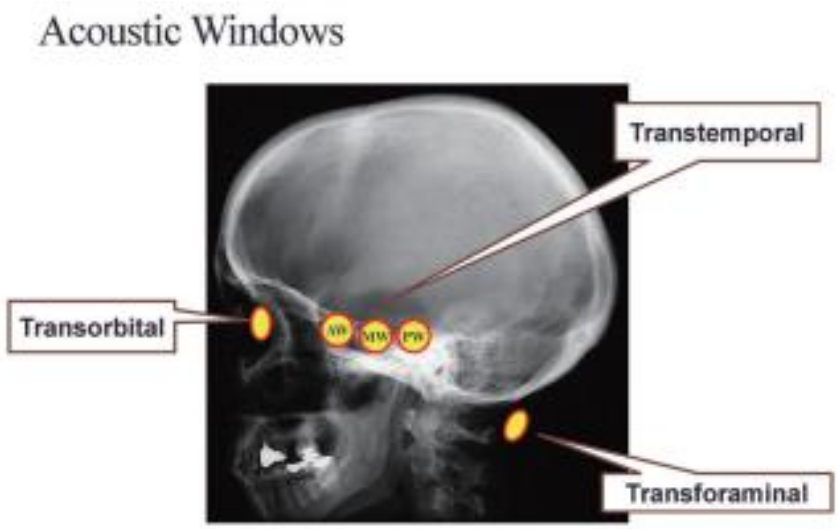
Infark serebral adalah komplikasi dari meningitis tuberkulosis. [6,7] Komplikasi vaskular sering bertanggung jawab untuk infark serebral dan gejala sisa neurologis pada orang dewasa yang selamat dari meningitis tuberkulosis.[7]. Literatur tentang penggunaan TCD untuk mengevaluasi komplikasi vaskular pada meningitis tuberkulosis pada orang dewasa masih jarang.

Penelitian Mei-Ling et al, berhipotesis bahwa pola vaskulopati akibat meningitis tuberkulosis akan serupa dengan vasospasme pada pasien dengan perdarahan subarachnoid (SAH), dalam bentuk peningkatan kecepatan aliran di arteri intrakranial yang terkena dan rasio Lindegaard yang meningkat. TCD berperan dalam diagnosis dan pemantauan vaskulopati akibat meningitis tuberkulosis pada arteri intracranial utama. [15]

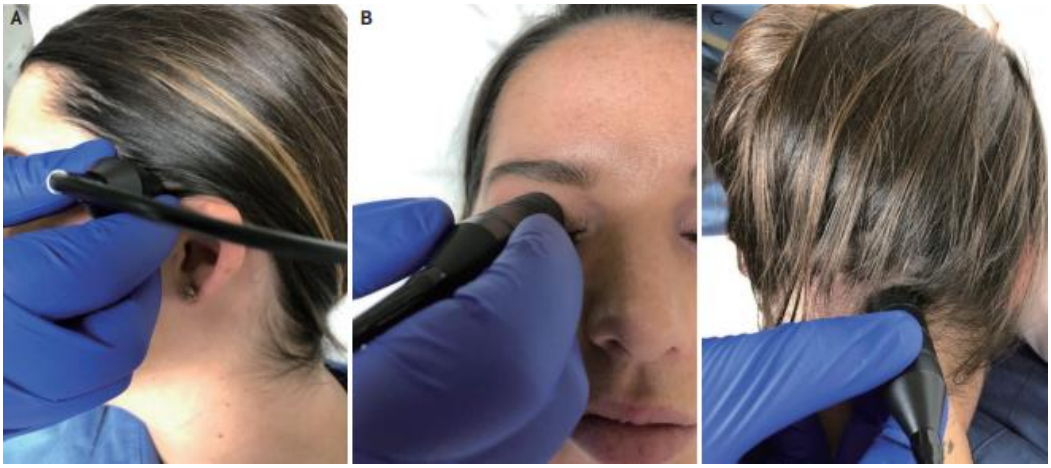
Meningitis tuberkulosis didiagnosis dari gambaran klinis yang sesuai, profil biokimia cairan serebrospinal (CSF) abnormal dan pemeriksaan basil tahan asam (BTA) pada apusan langsung, kultur, reaksi berantai polimerase (PCR) atau biopsi. [9] Diagnosa pasti meningitis tuberkulosis ditegakkan jika cairan serebrospinal (CSF) *acid-fast bacilli* (AFB) apusan langsung/kultur mikobakteri/reaksi rantai polimerase (PCR) untuk mikobakteri tuberkulosis menujukkan nilai positif. [9] Selain itu, basil tahan asam (BTA) terlihat dalam konteks perubahan histopatologis yang konsisten dengan tuberkulosis di otak atau sumsum tulang belakang, bersama dengan gejala, tanda dan perubahan CSF yang menunjukkan meningitis tuberkulosis (pada otopsi) juga merupakan kriteria untuk diagnosa pasti meningitis tuberkulosis. [9]

TCD

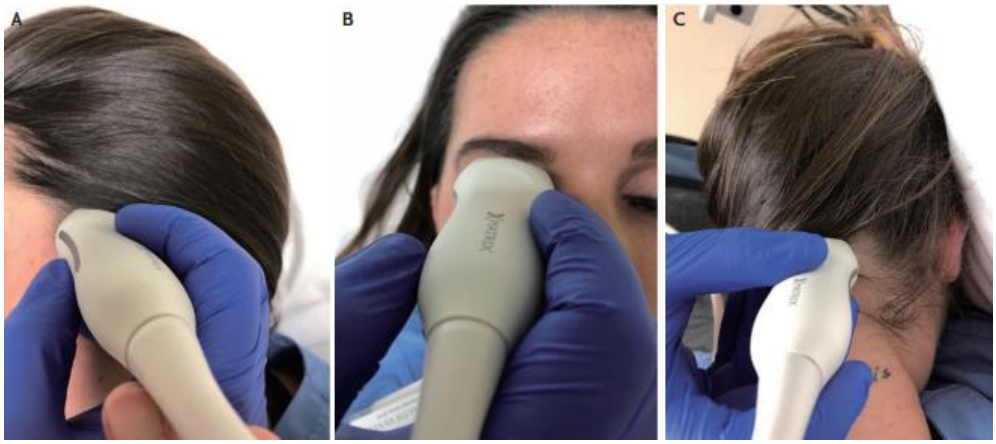
TCD menggunakan gelombang suara frekuensi rendah (1,5–2 MHz) yang dapat menembus secara dalam dengan sedikit atenuasi untuk memeriksa arteri intrakranial melalui “jendela” atau “lubang” di kepala. Untuk mengatasi tulang kepala yang membatasi penetrasi gelombang suara, gelombang suara dikirimkan melalui *acoustic windows* (jendela akustik) pada tulang kepala yang tipis (Gbr. 1-3). Tiga jendela akustik yang umum digunakan adalah jendela temporal, orbital, dan suboksipital. Jendela temporal melalui bagian paling tipis dari tulang temporal memungkinkan insonasi arteri serebral tengah (MCA), arteri serebral anterior (ACA), arteri serebral posterior (PCA), dan arteri karotis interna terminal. Jendela orbital dapat memberikan akses ke arteri oftalmikus (OA) dan karotis siphon dari arteri karotis interna (sICA). Jendela suboksipital melalui foramen magnum menyediakan akses ke bagian intrakranial dari arteri vertebralis (VA) dan arteri basilar (BA). [10]



Gambar 1. Jendela akustik. AW: anterior window, MW: middle window, PW: posterior window. [10]



Gambar 2. Jendela akustik untuk transcranial Doppler. (A) Temporal window. (B) Orbital window. (C) Suboccipital window. [10]



Gambar 3. Jendela akustik untuk transcranial color Doppler. (A) Temporal window. (B) Orbital window. (C) Suboccipital window. [10]

Tabel 1. Kecepatan rata-rata, arah, jendela akustik arteri intrakranial normal. [10]

Artery	Window	Depth, mm	Direction	MFV, cm/s
MCA M1 (M2)	Temporal	40–65	⇨ ▸	<80
ACA A1	Temporal	62–75	⇦ ▸	<80
PCA	Temporal	60–68	⇔ ▸	<50
ICA Siphon	Orbital	60–64	⇔ ▸	<70
OA	Orbital	50–62	⇨ ▸	Variable
BA	Suboccipital	80–100	⇦ ▸	<60
VA	Suboccipital	45–80	⇦ ▸	<50

MFV; mean flow velocity, MCA; middle cerebral artery, ACA; anterior cerebral artery, PCA; posterior cerebral artery, ICA; internal carotid artery, OA; ophthalmic artery, BA; basilar artery, VA; vertebral artery.

TCD dilakukan menggunakan mesin TCD 2-MHz. Pasien dievaluasi dengan TCD dalam waktu 2 minggu rawat inap dan 2 minggu kemudian. Evaluasi TCD tambahan dilakukan pada beberapa pasien jika ada perburukan klinis. Beberapa pasien menjalani evaluasi TCD lebih lanjut pada 3 dan 6 bulan. [15]

Kecepatan aliran darah sistolik, diastolik dan rata-rata (Vmean) arteri intrakranial utama diukur untuk berbagai arteri intrakranial, berinsonasi melalui jendela transtemporal, transorbital dan transforaminal. Vmean dihitung sebagai: (Kecepatan puncak sistolik-kecepatan akhir diastolik)/3 + kecepatan akhir diastolik. Vmean 60-90 cm/s mewakili kisaran normal untuk arteri serebri media. [10,11] Pada pasien dengan hidrosefalus, TCD dilakukan setelah penyisipan drainase ventrikel eksternal .

Indeks pulsatilitas (PI) diperoleh untuk setiap arteri intrakranial sebagai (Kecepatan sistolik puncak-kecepatan akhir diastolik)/kecepatan aliran rata-rata. Nilai 0,6 - 1,1 mewakili kisaran normal untuk PI arteri intrakranial. [11]

Ada tiga fase vaskulopati terkait meningitis tuberkulosis seperti yang ditentukan oleh TCD. Pada vaskulopati fase I, TCD menunjukkan peningkatan Vmean dan penurunan PI normal hingga sedang. Pada Fase II, Vmean berkurang dan PI berkurang. Pada Fase III, hampir tidak ada aliran darah di setidaknya satu arteri basal. PI sangat rendah dan dapat mendekati 0. Pasien pada fase III memiliki Vmean <40 cm/s yang mengakibatkan defisit neurologis residual yang berat atau kematian. [11]. Evaluasi dari tiga fase TCD dibuat pada semua pasien meningitis tuberkulosis. [11,12]

Kriteria yang digunakan untuk diagnosis vaskulopati MCA adalah sebagai berikut [12,13]:

1. Vmean >120 cm/s pada MCA yang terkena
2. Kecepatan aliran sistolik puncak (PSV) >157 cm/s pada MCA
3. Perbedaan kecepatan rata-rata sisi ke sisi dalam MCA >30 cm/s.

Selanjutnya, Vmean >100 cm/s pada arteri serebral anterior (ACA) yang terkena, Vmean >95 cm/s di arteri basilar (BA), dan Vmean >85 cm/s di arteri serebral posterior (PCA) yang terkena, menunjukkan vaskulopati di masing-masing pembuluh darah. [12,13] Vmean >85 cm/s pada arteri vertebralis dan Vmean >100 cm/s pada siphon arteri karotis interna mewakili vaskulopati akibat meningitis tuberkulosis. [15]

Rasio Lindegaard dihitung sebagai rasio Vmean MCA terhadap Vmean arteri karotis interna extracranial (rasio MCA/ICA). [12,13] Penilaian pada pasien dengan rasio Lindegaard lebih dari tiga dan lebih dari enam, dibuat. Vaskulopati berat didefinisikan sebagai rasio Lindegaard lebih dari enam. [15]

TCD memberikan informasi akurat tentang kecepatan aliran darah intrakranial dan mengidentifikasi area stenosis intrakranial. [6,13] TCD adalah tes non-invasif dan relatif murah. TCD dapat dilakukan di samping tempat tidur, menjadikannya alat yang penting pada pasien yang sakit kritis dan pasien yang menggunakan ventilator. [7]

TCD telah digunakan dalam evaluasi arteri intrakranial dengan meningitis tuberkulosis pada anak-anak. [7] Namun, perubahan hemodinamik serebral pada orang dewasa mungkin tidak serupa karena mungkin diperangaruhi sistem saraf otonom yang lebih matang.

Vaskulopati akibat meningitis tuberkulosis adalah penyakit yang dinamis dan karenanya, mungkin mencerminkan perjalanan alami dari proses penyakit serta respons terhadap berbagai strategi pengobatan. Di luar tingkat toleransi hemodinamik tertentu, vaskulopati akibat meningitis tuberkulosis dapat menyebabkan infark serebral dan cacat permanen. Evaluasi awal perubahan hemodinamik serebral dapat membantu dalam pengelolaan pasien meningitis tuberkulosis yang kritis. [9] Selain itu, pemantauan TCD pada meningitis tuberkulosis dapat memandu pengelolaan peningkatan tekanan intracranial. [11]

Meskipun meningitis tuberkulosis adalah proses general, vaskulopati meningitis tuberkulosis yang melibatkan kedua MCA hanya pada 16,7% pasien didapat dari sebuah studi. Ini jauh lebih rendah dibandingkan dengan beberapa kasus pada anak-anak dengan meningitis tuberkulosis, di mana hingga 70% pasien mengalami vaskulopati MCA bilateral. [7]

Hampir semua pasien yang datang pada Fase II mengalami penurunan Vmean dengan PI normal atau meningkat. Hanya 9,1% pasien yang mengalami penurunan Vmean dan penurunan PI. Temuan ini menunjukkan vaskulopati yang lebih difus. [14]

Kilic et al menemukan korelasi yang kuat antara tiga fase meningitis tuberkulosis dan GCS. Penelitian ini menunjukkan bahwa Vmean di MCA lebih tinggi pada pasien dengan skor GCS 14 dan 15. Ada hubungan yang konsisten dari penurunan Vmean dan peningkatan PI dengan penurunan GCS mendukung vaskulopati difus. [14]

Dari suatu studi didapat 13,3% pasien dengan vaskulopati meningitis tuberkulosis fase I mengalami hemiparesis permanen. [14]

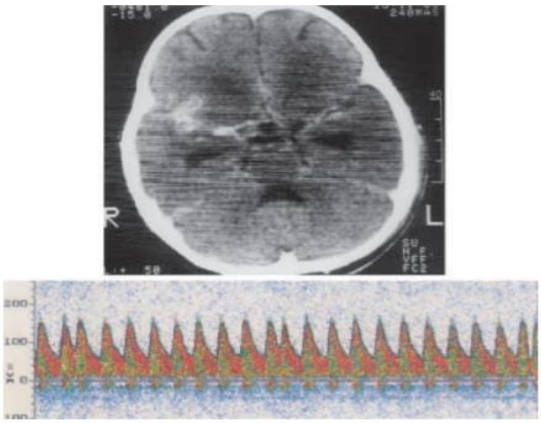
Sebuah studi melaporkan kelainan pembuluh darah otak pada meningitis bakteri akut dalam jangka pendek dan terjadi dalam dua sampai tiga minggu pertama infeksi. [13] Abnormalitas hemodinamik maksimum tercatat dalam 3 sampai 5 hari pertama. [9,11]. Literatur menunjukkan kelainan hemodinamik dapat bertahan hingga 4 bulan. Kronisitas peradangan yang berhubungan meningitis tuberkulosis sudah permanen, dan ini dapat berkontribusi pada perubahan hemodinamik yang berkepanjangan. [12,13] Selain itu, jangka waktu yang panjang dari peningkatan kecepatan aliran darah otak, menunjukkan bahwa stenosis yang terjadi disebabkan oleh vaskulitis, bukan vasospasme, merupakan mekanisme yang mungkin untuk iskemia serebral. [7]

Keterlibatan arteri intracranial dianggap sebagai salah satu penentu yang lebih penting pada meningitis tuberkulosis. [12,13,14]. Vmean yang lebih tinggi dengan PI yang lebih rendah telah dilaporkan terkait dengan hasil fungsional yang baik pada meningitis bakteri akut. [7]. Namun, hanya 27,8% dari pasien meningitis tuberkulosis kami mencapai hasil yang baik dalam 3 bulan, dibandingkan dengan 67% dari pasien meningitis bakteri akut. [12] Kemungkinan perjalanan klinis yang lebih lama dan tekanan intrakranial yang lebih tinggi untuk periode yang lebih lama berkontribusi pada insiden iskemia serebral yang lebih tinggi. [11,14,15]

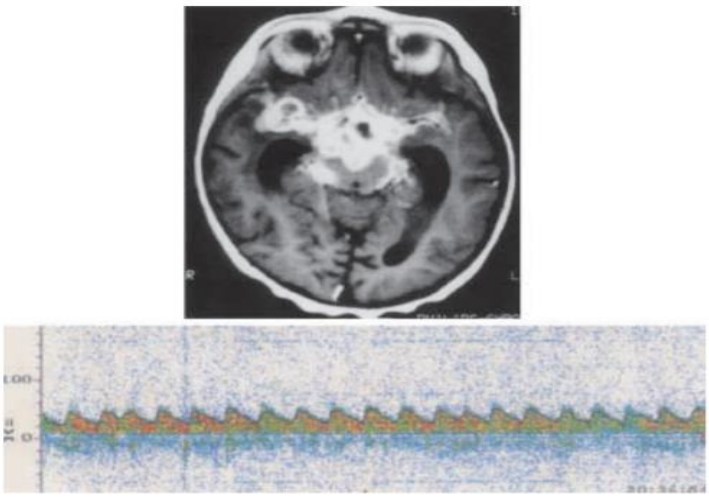
SIMPULAN

Sebagian besar pasien dengan meningitis tuberkulosis mengalami gangguan hemodinamik akibat penyempitan vaskular fokal yang dapat berlangsung berminggu-minggu dan bahkan menyebabkan iskemia parenkim. TCD adalah

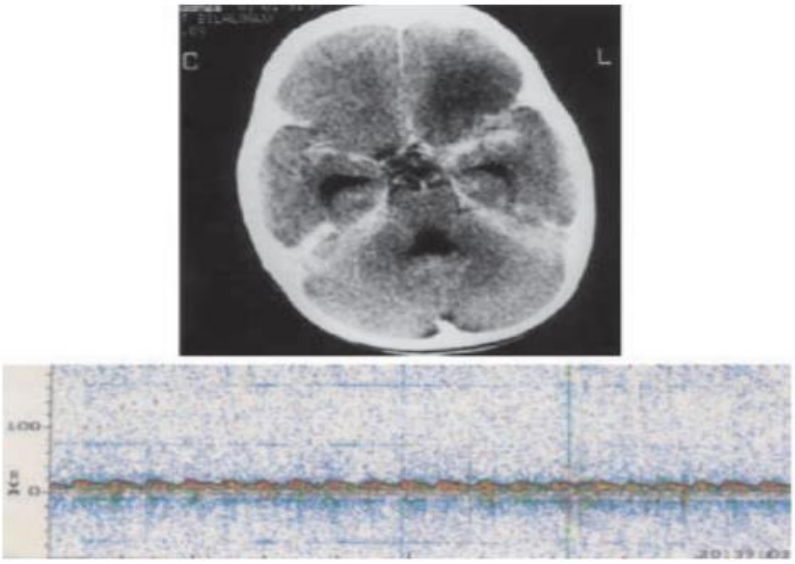
alat yang andal untuk diagnosis dan pemantauan perubahan hemodinamik ini dalam perjalanan alami penyakit serta menilai respons terhadap berbagai strategi terapeutik.



Gambar 4. Temuan radiologis dan TCD pada fase I: pemeriksaan CT scan dengan kontras terjadi penyangatan kontras di sisterna basal, menunjukkan reaksi inflamasi karena meningitis tuberkulosis. Pemeriksaan TCD pada MCA kanan menunjukkan peningkatan Vm (125 cm/s pada kasus ini), dengan penurunan PI normal hingga sedang (0,50 pada kasus ini), yang merupakan penyakit fase I. Gejala dan tanda klinis pada fase ini menyerupai serangan iskemik transien, dan bersifat reversibel jika penyakit tidak berlanjut. (14)



Gambar 5. Temuan radiologis dan TCD pada fase II: Sekuen T1WI pemeriksaan MRI dengan kontras dengan penyangatan kontras yang kuat pada sisterna basal, menunjukkan reaksi inflamasi akibat meningitis tuberkulosis. Setelah peningkatan awal pada fase I, pemeriksaan Doppler transcranial MCA kanan menunjukkan penurunan Vm (45 cm/s dalam kasus ini), dengan penurunan PI (0,40 dalam kasus ini), yang merupakan tanda-tanda penyakit fase II. Gejala dan tanda klinis pada fase ini biasanya tampak fokal defisit neurologis, yang mungkin ireversibel. (14)



Gambar 6. Temuan radiologis dan TCD pada fase III: pemeriksaan CT scan dengan kontras menunjukkan penyangatan kontras di sisterna basal, terjadi reaksi inflamasi karena meningitis tuberkulosis. Meskipun penyangatan kontras tidak seberat pada kasus yang diilustrasikan pada gambar 5, pemeriksaan TCD dari MCA kiri menunjukkan gangguan Vm yang berat (15 cm/s pada kasus ini) dan PI yang tidak terdeteksi, yang merupakan tanda penyakit fase III. Biasanya infark serebral terdeteksi sebagai infark tegas di lobus frontal, memiliki prognosis yang buruk. [14]

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Sinus Paranasalis

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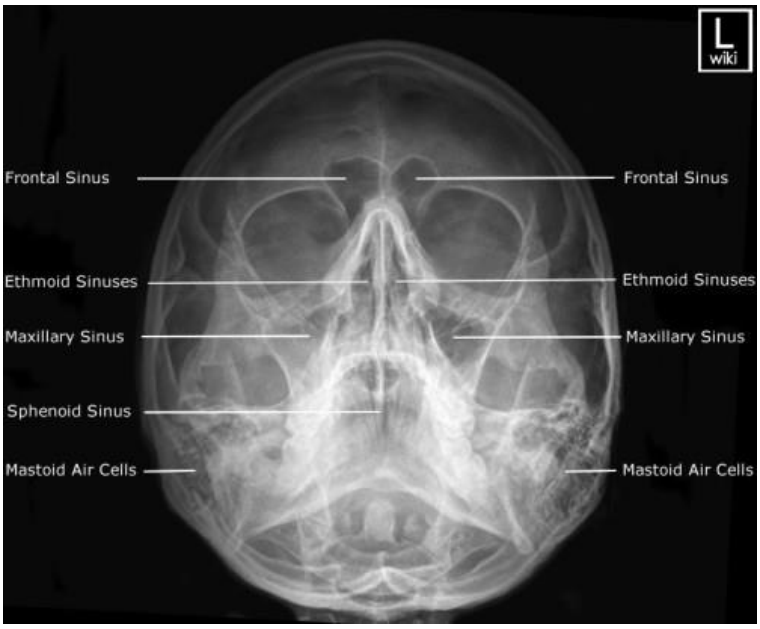
A. Anatomi Sinus Paranasalis

Rongga hidung atau dapat disebut kavum nasi memiliki bentuk seperti terowongan dari depan ke belakang. Bagian tengah rongga hidung dipisahkan oleh septum nasi sehingga menjadi kavum nasi kanan dan kiri. Masing-masing kavum nasi memiliki 4 dinding yaitu dinding medial, lateral, inferior dan superior (Lund, 2008).

Sinus paranasal merupakan ruang berisi udara yang terletak di dalam rongga tengkorak dan wajah. Sinus paranasal terbagi dalam 4 macam yakni: sinus maxilla, sinus frontalis, sinus ethmoid dan sinus sphenoid. Dalam kepentingan klinis, sinus paranasal terbagi dalam 2 kelompok, yakni kelompok anterior meliputi sinus frontalis, sinus maxillaris dan sinus ethmoidalis anterior yang bermuara di bawah konka media, serta kelompok belakang meliputi sinus ethmoidalis posterior dan sinus sphenoidalis yang bermuara pada beberapa lokasi di konka media. Garis pelekatan konka media pada dinding lateral hidung merupakan batas antara kedua kelompok. Salah satu fungsi penting sinus paranasal ialah sebagai sumber lendir dan tidak terkontaminasi sehingga dapat dialirkan ke mukosa hidung (Effendi, 1997).



Gambar 1 Anatomi sinus paranasal

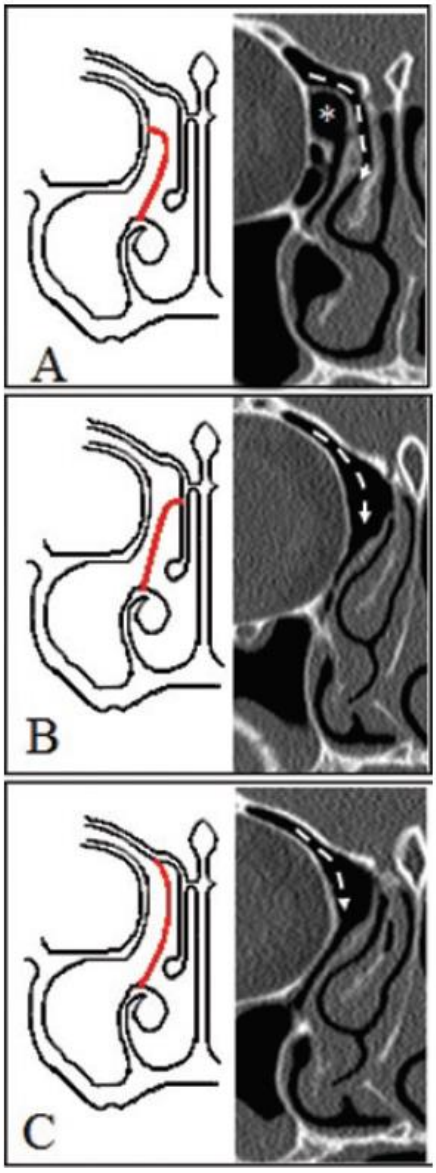
B. Embriologi Sinus Paranasalis

Secara embriologi, sinus paranasal berasal dari invaginasi mukosa rongga hidung dan mulai terjadi perkembangan pada usia fetus 3-4 bulan, kecuali pada sinus frontal dan sinus sphenoid. Sinus maxilla dan sinus ethmoid telah ada sejak lahir, sedangkan sinus ethmoid anterior berkembang pada anak usia kurng dari 8 tahun. Pada usia 8-10 tahun terjadi pneumatisasi sinus sphenoid yang berasal dari bagian postero-superior rongga hidung. Sinus-sinus tersebut biasa mencapai ukuran maksimal pada usia 15-18 tahun (Soetjipto dan Mangunkusumo, 2007).

C. Pola Drainase Sinus Paranasalis

Pola drainase sinus paranasalis memiliki kompleks ethmoid anterior yang berbatasan dengan sedara medial oleh turbin tengah. Bagian turbin superior membentuk hambatan medial pada sel ethmoid posterior. Turbin tengah dan superiori sering membagi dasar tengkorak melekat dan berlari ke potongan parasagital yang sama. Posisi vertikal lamela basalis turbin tengan diorientasikan pada potongan koronal, membanti bentuk anterior dari sel ethmoid posterior. Mengikurti penambahan turbin tengah dan superior, meatus tenagh dan superior dapat divisualisasikan dengan baik. Meatus superior, tengah dan inferior terletak pada ruang inferior dan lateral terhadap turbin.

Pada pemeriksaan potongan setengah sagital kompleks ethmoid, satu dapat menghargai lamela multipel, yang terletak pada sebuah oblik, kasarnya potongan paralel. Dari anterior ke posterior, penampakan lamela pertama ialah prosesus unsinatus, diikuti bulla ethmoid. Lamela ketiga dan keempat ialah basal lamela dari turbin tengah dan turbin superior. Lamela ini juga terlihat selama endoskopik selam apembedahan operatif sebagai kemajuan kerja pada aah anterior ke posterior. Aliran sinus sphenoid kedalam resesus sphenoethmoid terletak pada medial ke superior dan turbin teratas, lateral ke posterior dari nasal septum, inferior ke dasar tengkorak dan superior ke nasofaring (Frinadya, 2019).

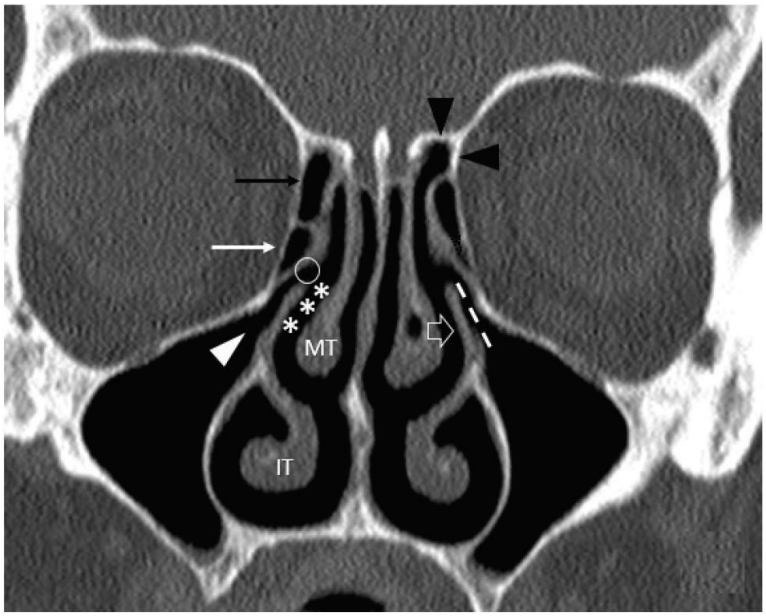


Gambar 2 Unicinate process (merah). (A) perlekatan pada lamina papiracea. Kantong buta tampak diantara uncinate dan laimna papyracea “recess terminalis (asterisk)”. Sinus frontal mengalir ke medial urcinate kedalam meatus tengah (panah putus-putus). (B) pemasangan ke turbin tengah. Sinus frontalis bermuara ke infundibulum ethmoid. (C) perlekatan pada dasar tengkorak. Juga, jalur drainase sinus fontal berakhir ke ethmoid infundibulum dengan tipe ini.

D. Macam Sinus Paranasalis

a) Kompleks Ostiomeatal (KOM)

Kompleks ostiomeatal (KOM) merupakan muara sempit dan rumit pada sepertiga tengah dinding lateral hidung. Kompleks ostiomeatal berfungsi sebagai muara saluran sinus maxilla, sinud frontal dan sinus ethmoid anterior. Kompleks ostiomeatal terlihat jelas pada potongan koronal sinus paranasal yaitu suatu rongga antara konka media dan lamia papirasea. KOM terdiri dari ostium sinus maxilla, infundibulum ethmoid yang bagian anteriornya berbatasan dengan prosesu sunsinatus, resesus frontalis dan sel-sel etmhmoid anterior dengan ostiumnya (Hwang, 2000).

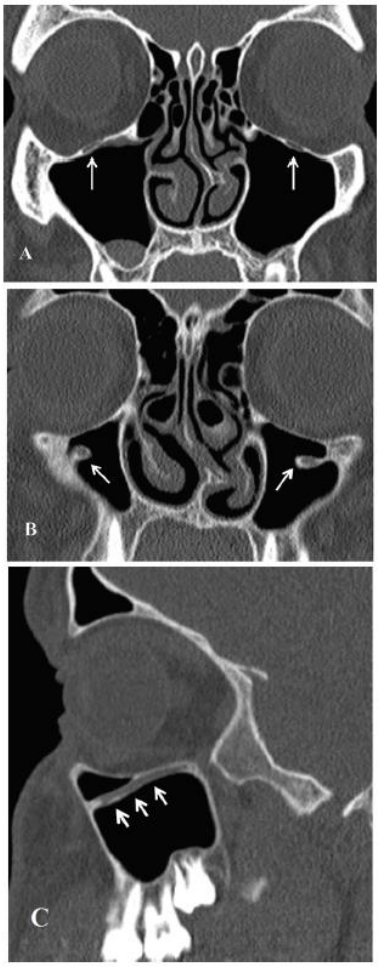


Gambar 3 CT-Scan coronal menunjukkan KOM: ethmoid bulla (Panah putih); sinus maxillaris ostium (panah putih); meatus tengah (tanda bintang); processus uncinate (panah berongga); hiatus semilunaris yakni ruang antara processus uncinatus dan ethmoid bulla (lingkaran putih); infundibulum ethmoid (haris putus-putus). Recess frontal ialah bagian dari KOM. Tampak recess suprabullar pada sisi kiri (panah hitam) yang merupakan ruang yang dibuat diatas ethmoid bulla ketika atap bulla tidak mencapai ke dasar tengkorak, superior. Pada sisi kanan, sel udara suprabullar (panah hitam); MT: middle turbin; IT: inferior turbinate.

b) Sinus Maxilla

Ostium sinus maxilla berbentuk piramid ireguler dengan dasarnya menghadap fosa anasalis dan puncak mengarah pada apeks prosesis zigomatikus os maxilla. Terletak arah terbuka kedalam pada superior dinding medial untuk drainase gerak silia kearah infundibulum etmodial. Infundibulum merupakan bagian dari sinus ethmoid anterior dan pembengkakan akibat radang atau alergi pada daerah ini akan menghalangi drainase sinus maxilla sehingga menyebabkan sinusitis. Dalam beberapa keadaan didapati sel haller atau sel ethmoid

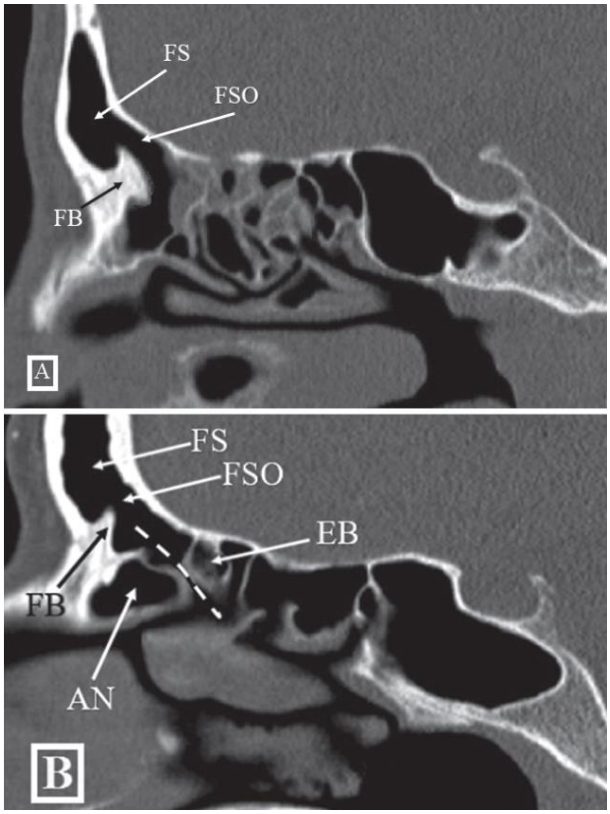
yang mengalami pneumatisasi kearah lateral diantara sinus maxillaris dan lantai orbita (Leung, Walsh, & Kern, 2014).



Gambar 4 CT-Scan coronal dan sagittal. (A) kanal tulang infraorbital dengann dinding kanal tulang yang tipis. (B) lokasi menyimpang bilateral dari kanal infraorbital. Terjadi penonjolan kedalam sinus yang menempatkan saraf berisiko cedera traumatis selama operasi sinus maxillais endoskopi. (C) tampilan sagittal untuk sinus maxillaris kiri pasien yang sama, menunjukkan abnormalitas kanal infraorbital melintasi sinus maxillaris.

c) Sinus Frontal

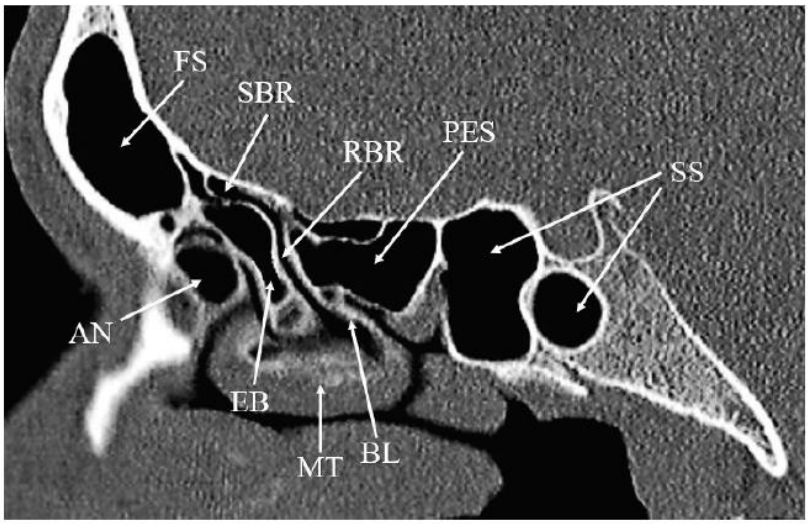
Sinus frontal memiliki struktur bersekat dengan tepi sinus berlekuk. Adanya infeksi sinus frontal ditandai dengan tidak adanya gambaran septum-septum dinding sinus pada foto rontgen. Sinus frontal dipisahkan oleh tulang relatif tipis dari orbita dan fosa serebri anterior, sehingga infeksi sinus frontal mudah menjalar. Sinus frontal berdrainase melalui ostiumnya pada resesus frontal yang berhubungan dengan infudibulum ethmoid (Punagi, 2008).



Gambar 5 CT-Scan parasagittal. (A) Frontal Beak (FB) menonjol sesuai dengan tingkat frontal sinus ostium (FSO). Superioir paruh ialah forntal sinus (FS). (B) Frontal beak (FB) yang cukup kecil sering berhubungan dengan sel agger nasi (AN) berukuran besar. Dapat diamati bahwa sel agger nasi yang esar akan menyebabkan penyempitan signifikan dari recess frontal. Saat sel agger nasi membentuk dinding anterior recess, ethmoid bulla (EB) membentuk posterior dinding. Jadi, setiap pembesaran atau patologi yang mempengaruhi salah satu sel maka dapat membahayakan patensi recess frontal.

d) Sinus Ethmoid

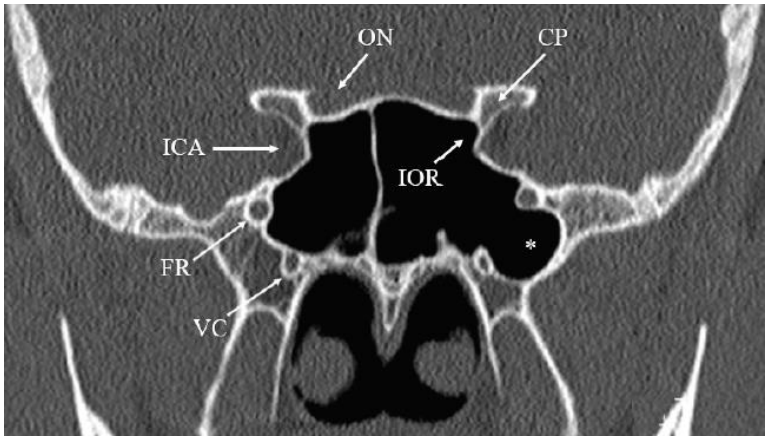
Sinus ethmoid merupakan fokal infeksi bagi sinus-sinus lainnya. Hal ini menjadikan sinus ethmoid merupakan jenis sinus yang paling bervariasi dari semua sinus paranasal. Sinus ethmoid digambarkan seperti dengan bagian inferior dan anterior kompleks. Dinding lateral dari sinus ethmoid atau lamina papirasea merupakan dinding medial orbita. Sinus ethmoid memiliki bentuk seperti rongga-rongga meyerupai sarang tawon, yang terletak pada bagian kateral os ethmoid antara konka media dan dinding medial orbita dengan jumlah yang bervariasi. Pada orang dewasa, sinus etmooid berbentuk seperti piramid dengan posterior pada bagian dasar. Ukuran dari anterior ke posterior mencapai 4-5 cm, tinggi 2,5 cm dan lebar 0,5 cm pada bagian anterior dan 1,5 cm posterior (Marquez, Tessema, Clement, & Schaefer, 2008).



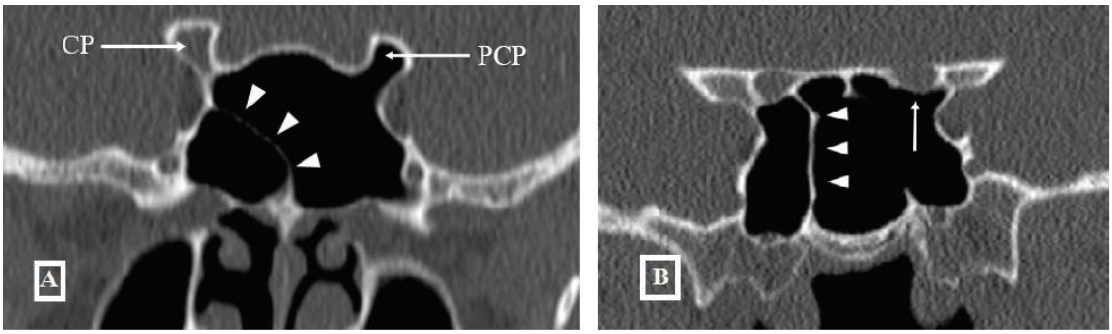
Gambar 6 CT-Scan parasagittal menunjukkan ethmoid bulla (EB) yang tidak meluasi ke superior dasar tengkorak, celah dibuat antara dan dasar tengkorak dikenal sebagai suprabullar recess (SBR). Juga, tampak celah antara dinding posterior bullar dan lamella basal yang disebut sebagai retrobullar recess (RBR); FS: frontal sinus; AN: agger nasi cell; MT:

e) Sinus Sphenoid

Sinus sphenoid memiliki bentuk menyerupai tonjolan yang terletak pada lateral septum nasi. Saat sinus sphenoid dibuka dan mengangkat bagian dinding anterior, maka akan tampak konfigurasi khas dari bagian dalam sinus sphenoid diantaranya tonjolan sela tursika, kanalis optikus dan indentasi arteri karotis. Sinus sphenoid mengalirkan sekretnya mengarah pada meatus superior bersama ethmoid posterior. Sinus sphenoid mulai terbentuk pada usia janin 3 bulan. Sinus sphenoid terbentuk sebagai pasangan evaginasi mukosa pada bagian posterior superior kavum nasi. Perkembangannya berjalan lambat, hingga pada waktu lahir evaginasi mukosa ini belum tampak berhubungan dengan kartilago nasalis posterior maupun os sphenoid. Sebelum anak berusia 3 tahun, sinus sphenoid berukuran kecil telah berkembang sempurna pada usia 12 hingga 15 tahun (Alsaied, 2017).



Gambar 7 CT-Scan coronal pada sinus sphenoid menunjukkan beberapa struktur saling berdekatan. ON: saraf optik; ICA: segmen cavernosa dari arteri karotis interna; FR: foramen rotundum dan saraf V2; VC: video kanal. Pada sinus hiperpneumatisasi, ketika pneumatisasi meluas ke lateral antara foramen rotundum dan kanalis vidianus, menciptakan reses yang dikenal sebagai reses lateral (asterisk). Ketika pneumatisasi meluas dibawah saluran optik "antara" kanalis optikus dan arteri karotis interna, resesus infraoptik "optikokarotid (IOR); CP: proses clinoid anterior.



Gambar 8 CT-Scan coronal sinus sphenoid menunjukkan (A) septum intersinus sphenoid menyimpang dan melekat pada kanalis arteri karotis interna kanan. Juga terjadi perluasan pneumatisasi ke klinoid anterior kiri (PCP: Pneumatized clinoid process). Clinoid Process (CP) bagian kanna diindikasikan sebagai perbandingan. (B) Deviasi septum intersphenoid yang melekat pada kanalis optikus kanan. Tulang inferior tampak mengecil dengan sisi kiri merupakan dinding saluran saraf optik.

E. Pencitraan Sinus Paranasalis

a) Pencitraan Posisi Waters

Kriteria pencitraan posisi waters akan tampak sinus maxillaris dan fossa nasalis; orbita dan sinus maxillaris simetris; jarak antara batas lateral tengkorak dan batal lateral orbita sama; petrous bagian inferior terproyeksi dibawah sinus maxillaris; tampak marker R/L dan kolimasinya sesuai dengan objek yang diperiksa.

Gambar 9 Penciraan Posisi Waters

Gambar 10 Pencitraan Posisi Waters

b) Pencitraan CT-Scan (*Computed Tomography Scan*)

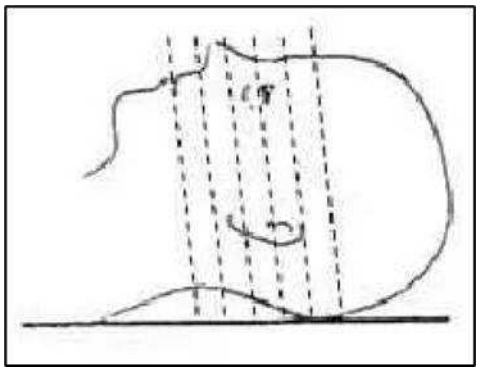
Gambaran CT scan pada keadaan sinus paranasalis akan menunjukkan:

1) Dinding sinus mengalami retraksi kedalam dan lantai orbita tertarik kebawah.
2) Berkurangnya volume antrum maxilla dengan retraksi seluruh dinding sinus
3) Kompensasi augmentasi volume orbita ipsilateral
4) Gambaran radioopak pada sisi sinus yang terlibat
5) Prosessus uncinatus yang terealisasi dan meatus media yang melebar dengan retraksi konka media yang bervariasi serta adanya deviasi septum nasi
6) Demineralisasi dinding sinus
7) Meluasnya bantalan lemak retroanal

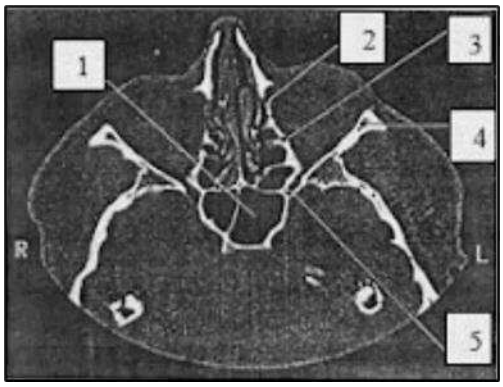
Pemeriksaan CT-Scan sinus paranasalis dapat dilakukan dengan dua jenis potongan sebagai berikut:

(a) Potongan Axial

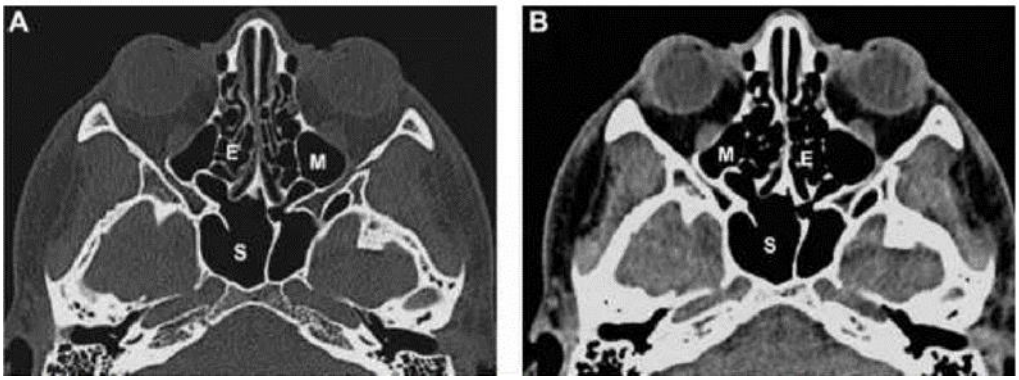
a. Posisi pasien; pasien berbaring supine senyaman mungkin diatas meja pemeriksaan, kedua lengan berada di samping tubuh, kaki diarahkan lurus kebawah dan kepala berada diatas bantalan kepala.
b. Posisi objek; kepala diletakan tepat di terowongan gantry, mid sagital plane segaris tengah meja, mid axial kepala tepat pada sumber terowongan gantry.



Gambar 11 Posisi CT-Scan potongan axial



Gambar 12 Hasil CT-Scan Potongan Axial (1) Sphenoid Sinus (2) Lacrimal Bone (3) Ethmoid bone (4) Zygoma (5) Superiori Orbital Fissure

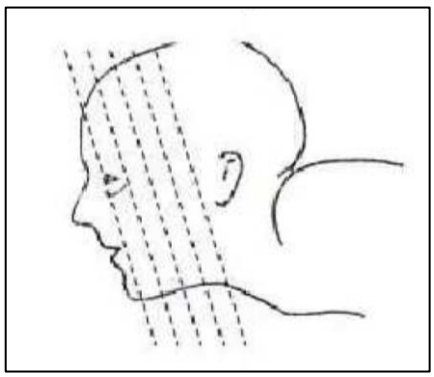


Gambar 13 Hasil CT-Scan aksial sinus paranasal pada sinus ethmoid, (A) algoritma tulang; dan (B) algoritma jaringan lunak

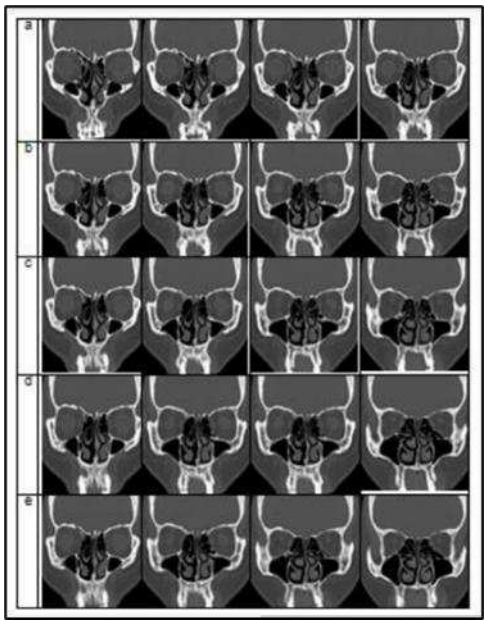
(b) Potongan Coronal

a. Posisi pasien; pasien berbaring prone diatas meja pemeriksaan dengan bahu diganjal bantal, kepala digerakkan kebelakang (hiperesktensi) sebisa mungkin dengan membidik menuju vertikal, gantry diarahkan sejajar dengan tulang-tulang bawah.

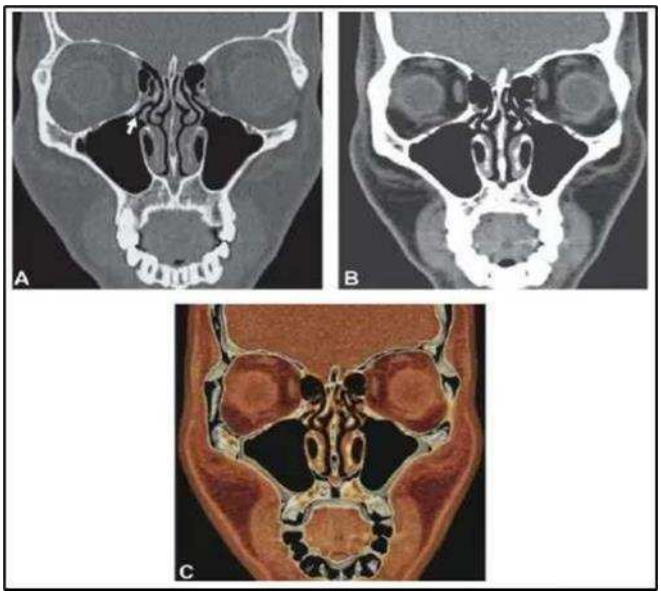
b. Posisi objek; kepala tegak atau diarahkan kebelakang (hiperekstensi) sebisa mungkin dan diberikan alat fiksasi agar posisi kepala tetap stabil.



Gambar 14 Posisi CT-Scan Potongan Coronal



Gambar 15 Hasil CT-Scan Potongan Coronal (a) 1 mm (b) 1,5 mm (c) 2 mm (d) 2,5 mm (e) 3 mm (Yulianarrahma, et al, 2020)

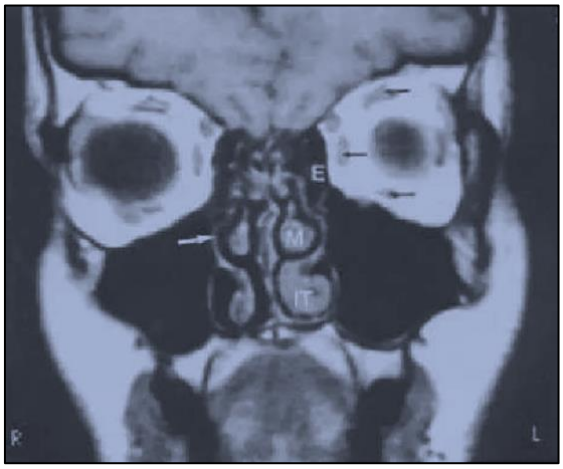


Gambar 16 Hasil CT-Scan coronal dari sinus paranasal pada tingkat reses alveolar maxilla, (A) algoritma tulang, (B) algoritma jatingan lunak dan (C) konstruksi 3D untuk menampakkan jalur drainase penting seperti unit osteomeatal

(c) Pencitraan MRI

Gambaran MRI pada keadaan sinus paranalis akan menunjukkan:

1) Opasitas sinus dan pengurangan volume sinus
2) Penonjolan lemak orbita
3) Penebalan lapisan sinus yang edema (Simbolon, Ratnawati, & Sutanegara).



Gambar 17 Hasil MRI Normal Sinus

F. Etiologi Agen Penyebab Sinus Paranasalis

Beberapa agen penyebab sinus paranasalis dijabarkan pada pembahasan sebagai berikut:

a) Jamur

Jamur penyebab infeksi sinus paranasalis biasanya berasal dari genus *Aspergillus* dan *Phaehyphomycosis*, *Mucor* dan *Rhizopus*. Insidensi abses otak karena infeksi fungsi semakin menignkat akibat penignkatan terapi kortikosterod, namun terapi antimikroba spektrum luas dan agen immunokompromais. Jenis jamur paling sering ditemui sebagai penyebab komplikasi abses otak ialah jamur *Candida* berupa mikroabses, makroabses dan difusi nodul glial (Octaviani, et al., 2012).

b) Bakteri

Bakteri ini termasuk pada grup *Streptococcus anginosis (milleri)* yakni flora normal pada rongga mulut, appendix dan traktur genitalia wanita. *Staphilococcus aureus* ditemukan pada 10 hingga 20% kasus yang umumnya ditemukan pada penderita dengan cedera kranial atau endokarditis infektif (HR, 2017). Bakteri yang sering ditemukan pada infeksi sinus paranasal, diantaranya: *Streptococcus pneumonia, Haemophlis influenza, Branhamella cataralis, Streptococcus alfa, Stpahylococcus aureud* dan *Streptococcus pyogenes* (Octaviani, et al., 2012).

c) Virus

Virus penyebab sinusitis biasanya terjadi pada infeksi saluran napas atas, infeksi virus yang lazim menyerang hidung dan nasofaring juga menyerang sinus. Mukosa sinus paranasalis berjalan kontinu dengan mukosa hidung dan penyakit virus yang menyerang hidung perlu dicurigai dapat meluas ke sinus. Antara agen virus tersering menyebabkan sinusitis antara lain: *Rhonovirus, Iinfluenza virus, Parainfluenza virus* dan *Adenovirus* (Octaviani, et al., 2012).

d) Parasit

Beberapa abses otak yang diketahui menjadi penyebab abses otak ialah kelompok helminthes dan protozoa seperti *Trypanosoma cruzi, Taenia solium, Entamoeba histolytica Microsporidia spp., Schistosoma spp.,* dan *Paragonimus spp. Toxoplasma gondii* pada penderita HIV merupakan parasit utama penyebab infeksi otak (Octaviani, et al., 2012).

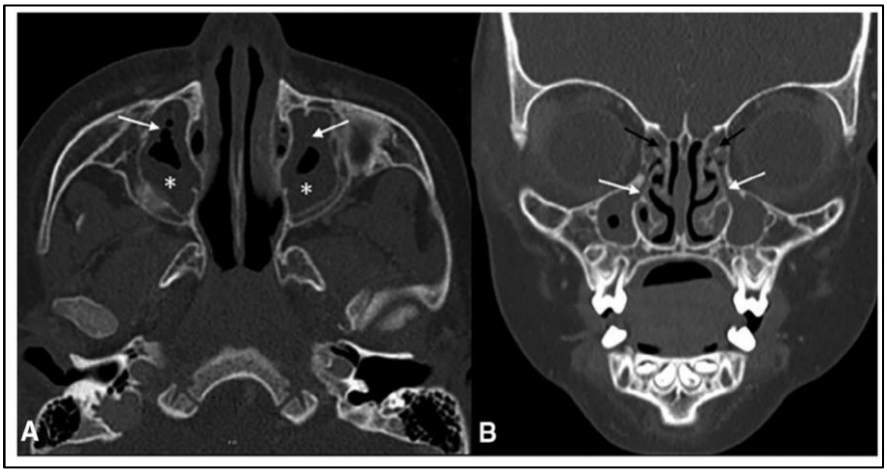
e) Mikroba

Mikroba yang paling sering diisolasi pada abses serebri dari sumber otitis adalah *Streptococcus spp, Enterobacteriaceae, Bacteroides spp. dan P. aeruginosa*. Abses serebri akibat komplikasi dari pasca pembedahan kranioserebral, dan jika memang terjadi biasanya karena *Staphylococci, Enterobacteriaeceae dan Pseudomonas spp*. merupakan mikroba penyebab yang sering ditemukan (Octaviani, et al., 2012).

G. Komplikasi Sinus Paranasalis

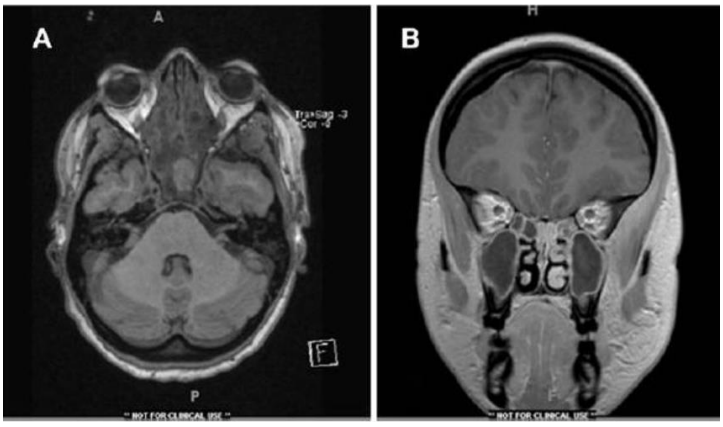
a) Komplikasi Intrakranial

Rute utama penyebaran infeksi intrakranial diawali melalui hematogen atau penyebaran vaskular (tromboflebitis retrograde melalui vena diploik), termasuk penyebaran infeksi secara langsung. Umumnya komplikasi intrakranial diklasifikasikan sebagai meningitis, abses epidural, subdural, empiema, CST dan abses intraserebral (Soetjipto D, Sinusitis. Dalam: Soepardi EA, Iskandar N, Bashiruddin J, Restuti RD, 2001).



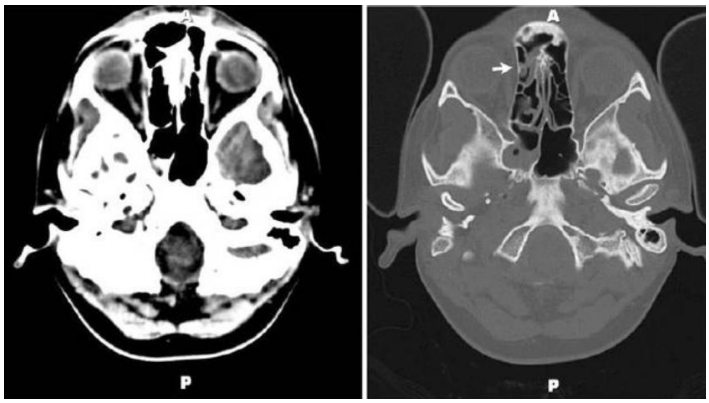
Gambar 18 Rhinosinusitis bakterialis pada bayi usia 20 bulan disertai demam. Gambar CT axial !) menunjukkan sekresi berbusa dan kadar cairan pada sinus maxillaris; gambar CT coronal B) menunjukkan adanya obstruksi kompleks osteomeatal dan opasifikasi bagian kompleks ethmodial

Thrombosis Sinus Cavernous (TSC)



Gambar 19 CT-Scan kepala non kontras pada Thrombosis Sinus Cavernosa (TSC)

Keadaan tersebut (gambar 12) menunjukkan adanya penebalan mukosa dalam diantara sphenois dan sinus ethmoid. Bone window dari studi yang sama lebih jelas menunjukkan kejadian sinus.



Gambar 20 MRI kepala dan orbita tanpa kontras

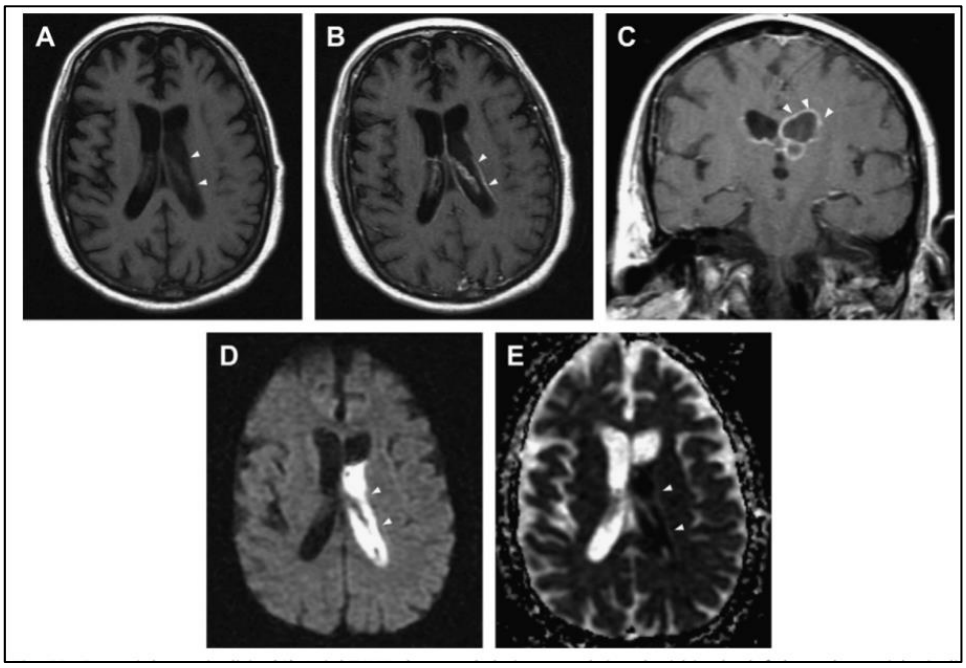
Berdasarkan hasil pencitraan MRI (gambar 13) dapat dinyatakan gambar A) merupakan sisi aksial tampak sinusitis luas; gambar B) merupakan sisi coronal tampak penebalan pada sinus cavernosus dengan ruang abses (Sumantra & Marzuki, 2014).

b) Thrombosis Sinus Venous Serebral (TSVS)

Trombosis Sinus Venosus Serebral (TSVS) merupakan suatu penyakit yang disebabkan oleh oklusi struktur vena intrakranial termasuk sinus serebral, vena korteks dan bagian proksimal vena jugularis. Awal kejadian TSVS disebabkan karena kondisi protrombotik karena penyakit atau kondisi tertentu pasien. Kondisi protombotik ialah keadaan abnormal terjadinya peningkatan faktor koagulasi darah sehingga menyebabkan risiko terjadinya trombosis (Einhaupl K, 2010).

c) Ventriculitis

Ventriculitis merupakan komplikasi otak cukup langka. Ventriculitis dikelompokkan pada beberapa kasus yakni: ependymitis, abses intaventrikular, empiema ventrikel dan pyocephalus. Mikroorganisme penyebab ventrikulitis ialah *Staphylococcus* dan *Enterobacter.* Sejumlah 30% kasus ventrikulitis dialami pada pasien usia muda.



Gambar 21 Komplikasi ventrikulitis akibat bakteri. A) T1W1 axial menunjukkan peningkatan sinyal halus dalam ventrikel lateral kiri, yang menunjukkan adanya debris; B, C)T1W1 axial dan coronal setelah kontras menunjukkan peningkatan ependymal sepanjang ventrikel lateral kiri konsistem dengan ventriculitis; D, E) DWI dan peta ADC yang sesuai menunjukkan difusi terbatas dalam ventrikel lateral kiri, sugestif pembentukan abses.

d) Komplikasi Orbita

Dalam Hauser dan Fogarasi (2010) komplikasi orbita dapat diklasifikasian sebagai berikut:

(a) Selulitis periorbita: Merupakan keadaan peradangan kelopak mata ditandai dengana danya edema pada kelopak mata
(b) Selulitis orbita: Ialah perluasan peradangan edema pada orbita, ditandai dengan adanya proptosis, kemosis dan gangguan pergerakan bola mata. Perluasan ini berisiko abses orbita dan kebutaan.

(c) Abses periorbita (abses subperiosteal): lalah pembentukan dan pengumpulan pus antara periorbita dengan dinding tulang otbita, ditandai dengan proptosis perubahan letak bola mata, gangguan pergerakan bola mata dan penurunan visus. Abses subperiosteal orbita merupakan salah satu komplikasi akibat sinusitis paranasalis. Abses subperiosteal orbita terjadi karena adanya akumulasi pus purulen antara periorbita dan lamina papiracea yang paling umum disebabkan inflamasi sinus ethmoid (Hong S, 2017).

(d) Abses orbita: Ditemukan pembentukan dan enggumpalan pus pada orbita ditandai dengan optalmoplegi, proptosis dan kehilangan penglihatan.

(e) Trombosis sinus kavernous: Pada fase ini telah terjadi perluasan infeksi ke sinus kavernous yang ditandai dengan proptosis, optalmoplegi dan kehilangan penglihatan disertai perluasan tanda infeksi ke mata sehat hingga tanda-tanda meningitis (Hauser & Fogarasi, 2010) (Irfandy, Ambriani, & Vitresia, 2020).

(f) Abses septum nasi: Abses septum nasi dapat terjadi dikarenakan trauma nasal sehingga mengalami hematoma dan berakibat pada pembentukan abses.

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Middle Ear and Mastoid Infection Imaging

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Abstract

The ear is divided into three parts, namely the outer ear, middle ear and inner ear. The middle ear consists of the tympanic membrane, tympanic cavity, mastoid process, and Eustachian tube.

Middle ear infection or called otitis media is an inflammation of part or all of the middle ear mucosa. Otitis media is divided into suppurative and non-suppurative otitis media, which have acute and chronic forms, respectively. Acute otitis media belongs to the type of suppurative otitis media.Most cases of otitis media will experience infection and inflammation including acute otitis media with coalescent mastoiditis, acute otitis media with abscess, chronic otomastoiditis with ossicular erosion, chronic otomastoiditis with tympanosclerosis, pars flaccida cholesteatoma, pars Tensa cholesteatoma.In establishing the diagnosis of otitis media, it is based on the results of clinical examinations (anamnesis and otologic examination) and to determine the presence or absence of complications through radiological examinations (plain photos, CT scan and MRI of the mastoid). The best imaging for assessing chronic diseases of the middle ear and temporal bone (mastoid) including cholesteatoma is with a CT scan because it can show bone destruction.

PENDAHULUAN

Infeksi telinga bagian tengah atau disebut otitis media adalah suatu peradangan sebagian atau seluruh mukosa telinga tengah, tuba Eustachius, antrum mastoid dan sel-sel udara mastoid. Otitis media terbagi atas otitis media supuratif dan non-supuratif, di mana masing–masing memiliki bentuk akut dan kronis. Otitis media akut termasuk ke dalam jenis otitis media supuratif. Selain itu terdapat juga jenis otitis media spesifik, yaitu otitis media tuberkulosa, otitis media sifilitik dan otitis media adhesive.[1,2,3]

Otitis media supuratif kronik dianggap sebagai penyeba btuli yang terpenting dan merupakan infeksi kronik di telinga tengah dengan perforasi yang disertai secret secara terus menerus atau hilang timbul. Sekret yang dihasilkan bersifat encer, kental, bening ataupun nanah, onsetnya lebih dari 2 bulan. Penyakit ini memberikan rasa sakit dimulai pada fase hiperemis dan fase supuratif.

Otitis media supuratif kronik dengan kolesteatoma sering disebut sebagai tipe bahaya yang dapat menginvasi tulang dan mengakibatkan osteomyelitis atau destruksi tulang oleh kolesteatoma. Tendensi OSMK untuk menyebabkan komplikasi tergantung pada keadaan patologik yang menyebabkan otorea kronik, biasanya didapatkan pada tipe bahaya. Tindakan pembedahan bertujuan menghentikan sekre tsecara permanen dan membersihkan jaringan patologik, mencegah kerusakan fungsi lebih lanju takibat infeksi dan menghindari penderita dari komplikasi. Komplikasi didapatkan pada penderita OMSK tipe maligna seperti labirintitis, meningitis, abses otak yang dapat menyebabkan kematian. [1,2,3]

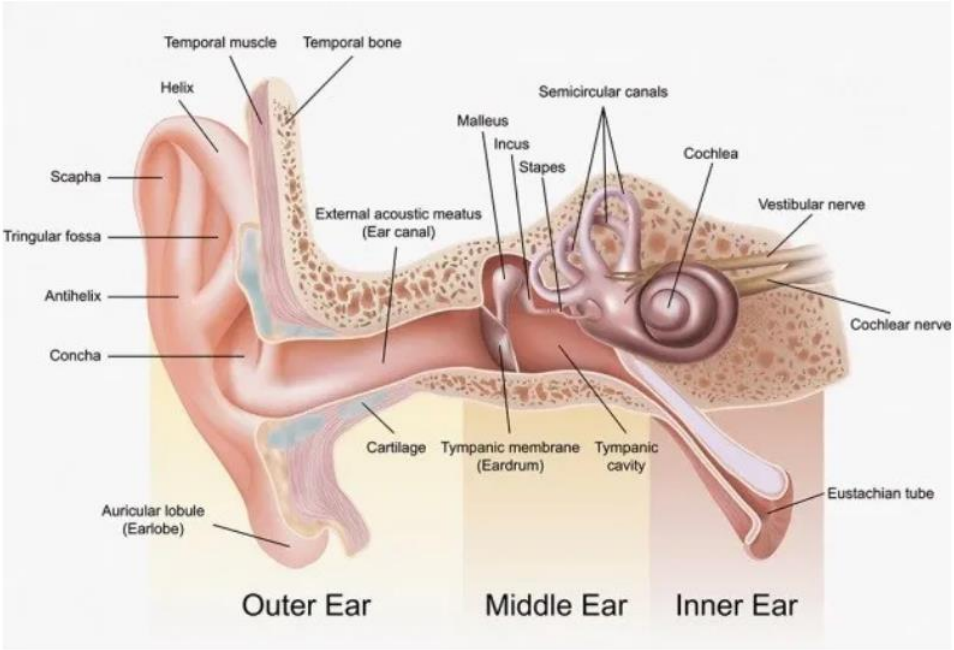
A. EPIDEMIOLOGI

Studi di seluruh dunia melaporkan bahwa prevalensi otitis media supuratif kronis bervariasi 4% hingga 33,3%. (Kumari, 2016). Perkiraan prevalensi OMSK berkisar antara 65-330 juta orang di seluruh dunia. Di Asia Tenggara, Afrika, dan Pasifik Barat, prevalensinya lebih tinggi dari pada di Amerika Utara dan Eropa, dimana prevalensinya kurang dari <2%. Laporan dari World Health Organization pada tahun 2004 memperkirakan bahwa

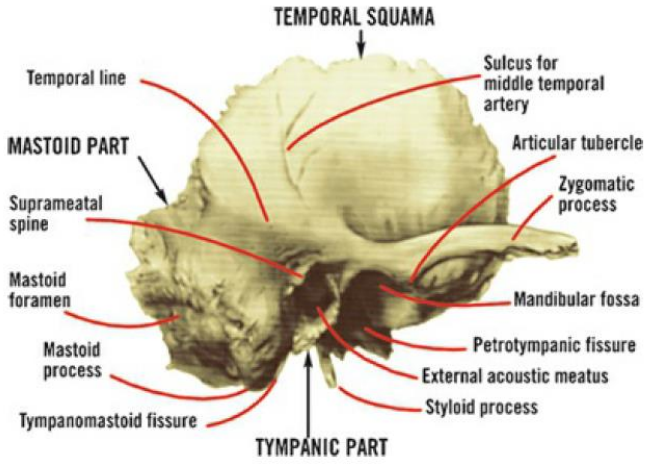
28.000 kematian per tahun di seluruh dunia disebabkan oleh OMSK. Otitis media supuratif kronis merupakan penyebab gangguan pendengaran paling penting.[7]

Hasil survey kesehatan indera penglihatan dan pendengaran tahun 1994-1996 yang dilaksanakan di tujuh provinsi di Indonesia menunjukkan prevalensi ketulian 0,4%, morbiditas telinga 18,5%. Di mana penyebab terbanyak morbiditas telinga tengah adalah otitis media supuratif kronis tipe jinak (3,0%).[6]

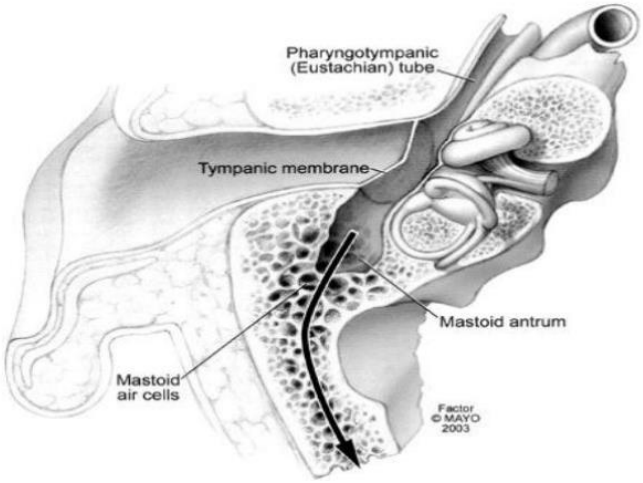
B. ANATOMI



Gambar 1. Anatomi telinga



Gambar 2. Tulang temporal kanan, aspek lateral.[12]



Gambar 3. Menunjukkan mastoid

Anatomi Telinga Tengah

Telinga tengah terdiri atas :

1. Membran timpani.
2. Cavum timpani.
3. Prosesus mastoideus.
4. Tuba eustachius

Klasifikasi

Klasifikasi otitis media dengan infeksi dan peradangan :

- Otitis Media Akut dengan koalesen mastoiditis
- Otitis Media Akut dengan abses
- Otomastoiditis kronik dengan erosi tulang pendengaran
- Otomastoiditis kronik dengan tympano sclerosis
- Pars flaccida cholesteatoma
- Pars Tensa cholesteatoma

C. PATOFISIOLOGI

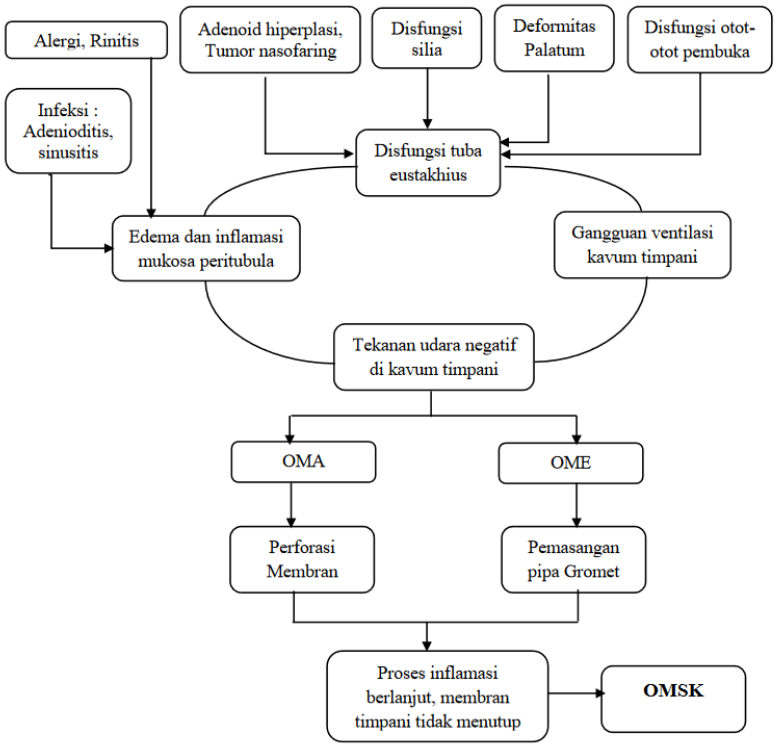
Patofisiologi dari OMA dimulai dari adanya iritasi dan inflamasi dari mukosa telinga tengah yang disebabkan oleh multifaktorial, diantaranya infeksi yang dapat disebabkan oleh virus atau bakteri, gangguan fungsi tuba, alergi, dan kekebalan tubuh yang terganggu. Sumbatan pada Tuba Eustachius merupakan factor utama penyebab terjadinya penyakit ini.[3,16,17]

Dengan terganggunya fungsi tuba Eustachius, terganggu pula pencegahan invasi kuman ke dalam telinga tengah sehingga kuman masuk dan terjadi peradangan. Gangguan fungsi tuba Eustachius ini menyebabkan terjadinya tekanan negatif di telingah tengah, yang menyebabkan retraksi dari membran timpani lalu terjadi pula respon inflamasi yang menyebabkan vasodilatasi pembuluh darah di membran timpani, protein plasma keluar dan terkumpulnya cairan yang menyebabkan efusi serta edema dan selanjutnya bila fungsi tuba tetap terganggu dan adany ainfiltrasi kuman patogen dan nasofaring dan rongga hidung akan menimbulkan supurasi. Akumulasi

cairan yang terus menerus menyebabkan membran timpani menonjol dan lama kelamaan membran timpani bisa perforasi. [3,16,17]

Penyebab tersering pada anak mendapa tinfeksi telinga tengah adalah karena struktur tuba pada anak yang berbeda dengan dewasa dan kekebalan tubuh yang belum berkembang sempurna sehingga bila terjadi infeksi jalan napas atas, maka lebih mudah terjadi infeksi telinga tengah berupa Otitis Media Akut (OMA).

Mayoritas OMSK merupakan kelanjutan atau komplikasi otitis media akut (OMA) yang mengalami perforasi. Namun, OMSK juga dapat terjadi akibat kegagalan pemasangan pipa timpanostomi (gromet tube) pada kasus otitis media efusi (OME). Perforasi membran timpani gagal untuk menutup spontan, sehingga mudah terjadi infeksi berulang dari telinga luar atau paparan allergen dari lingkungan. Keadaan ini menyebabkan otorea yang persisten. Komplikasi yang tersering dari OMSK adalah mastoiditis.



Gambar 12. Diagram patofisiologi

DIAGNOSIS

Otitis media adalah spektrum penyakit yang berhubungan dengan infeksi pada telinga tengah. Melakukan diagnosis tepat waktu memungkinkan pengobatan yang tepat dan dapat menghindari perkembangan patologi penyakit ini ke komplikasi yang serius seperti mastoiditis, meningitis, tromboflebitis sinus lateral, abses otak, kelumpuhan wajah. Strategi terapeutik terutama tergantung pada tahap otitis media akut (kongestif atau supuratif). Otitis media akut (OMA) adalah penyakit remisi spontan yang nyeri merupakan gejala yang paling menyusahkan.

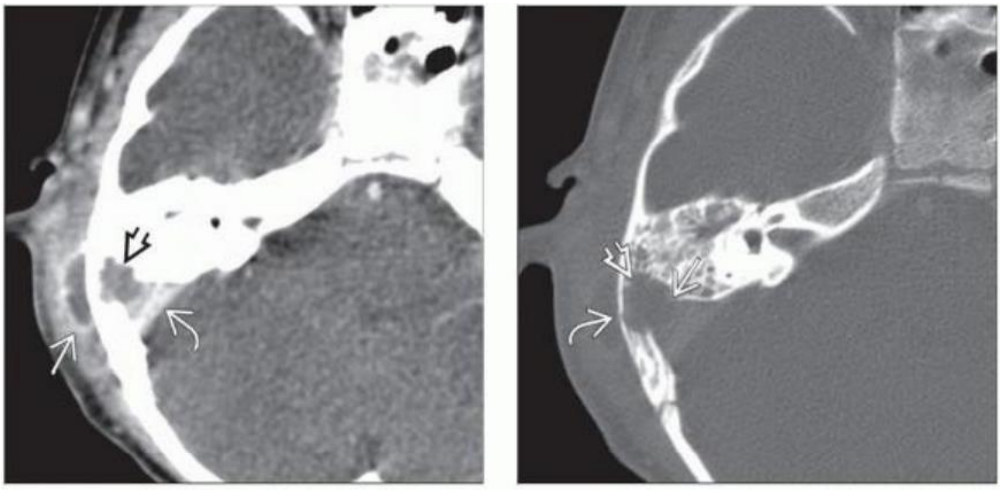
Untuk diagnose otitis media supuratif kronik. Penyakit telinga kronis ini biasanya terjadi perlahan-lahan dan penderita sering kali datang dengan gejala-gejala penyakit yang sudah lengkap. Pada maligna sekretnya lebihsedikit, berbau

busuk, kadangkala diserta ijaringan granulasi atau polip, maka secret yang keluar dapat bercampur darah. Adakalanya penderita datang dengan keluhan kurang pendengaran atau telinga bercampur darah.[18]

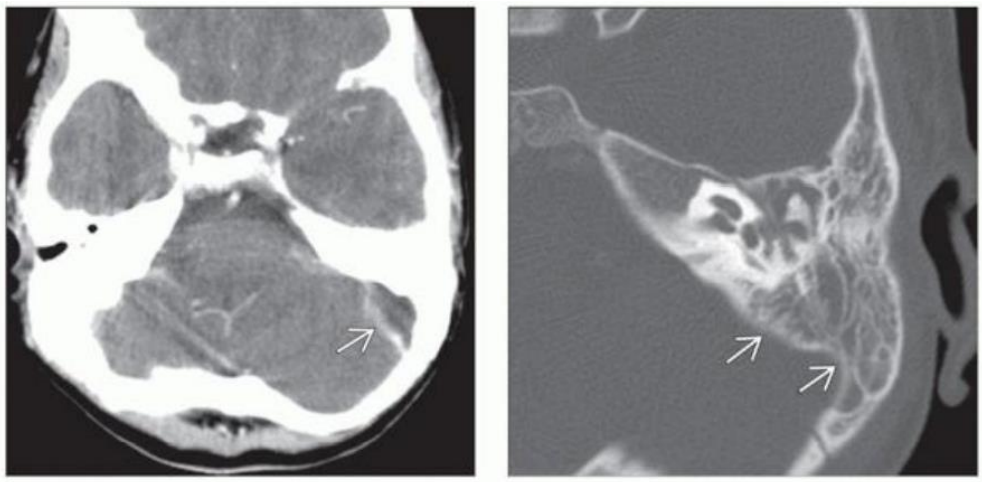
Radiologi konvensional, foto polos radiologi, posisi Schuller berguna untuk menilai kasus kolesteatoma, sedangkan pemeriksaan CT scan dapat lebih efektif menunjukkan anatomi tulang temporal dan kolesteatoma.[10]

PEMERIKSAAN RADIOLOGI

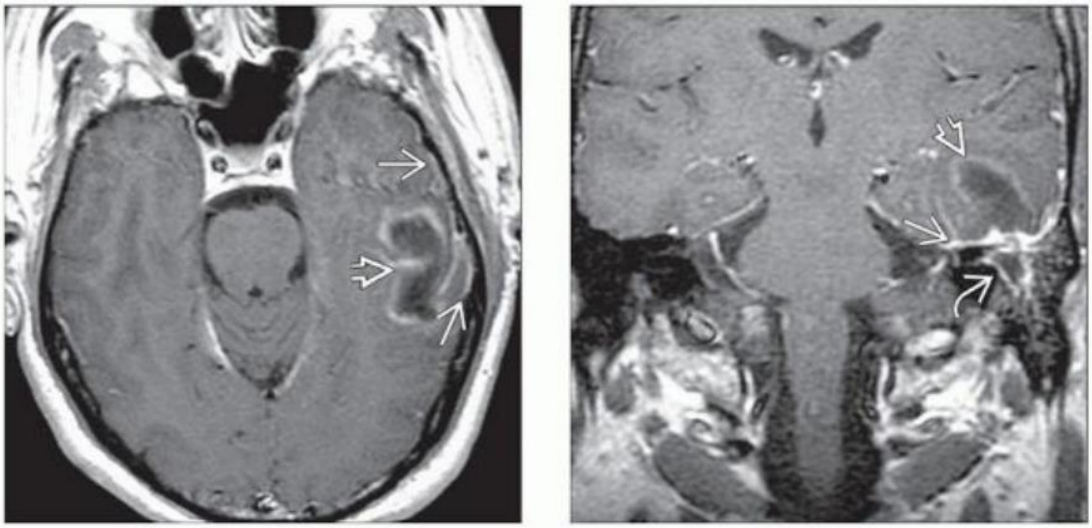
Otitis Media Akut dengan coalescent mastoiditis



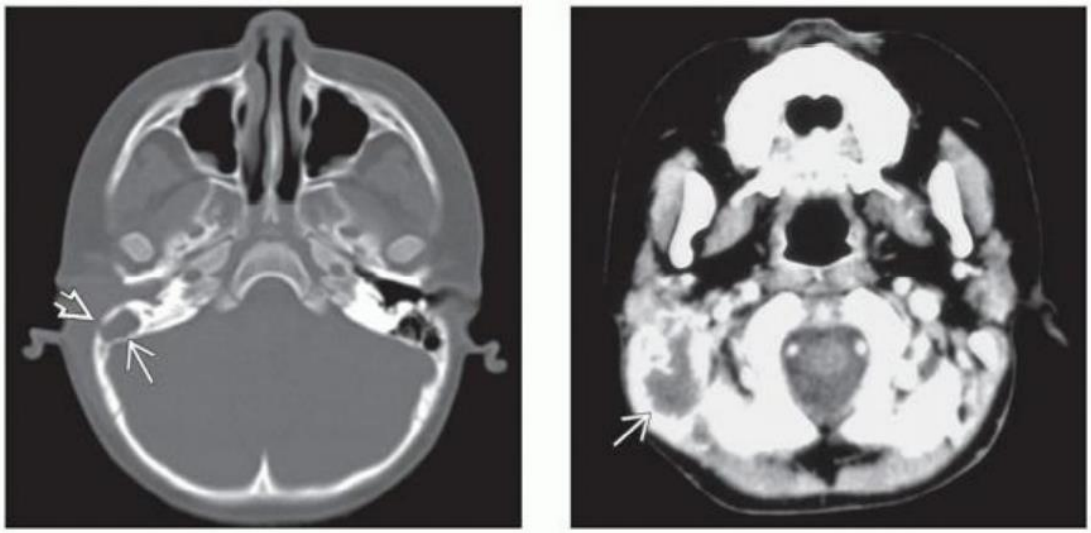
(Kiri) CECT aksial pada pasien dengan massa nyeri post-auricular dengan sakit kepala dan demam menunjukkan abses post-auricular, mastoiditis confluent, dan sinus transversal non thrombosed . (Kanan) CT tulang aksial pada pasien yang sama menunjukkan hilangnya trabekula mastoid menunjukkan sigmoid dehiscent dari konfluen mastoiditis. Celah halus di korteks mastoid lateral menunjukkan situs di mana nanah mastoid berkomunikasi dengan abses post-auricularis. [26]



(Kiri) CECT aksial pada anak dengan nyeri telinga dan penurunan kesadaran menunjukkan abses epidural yang berdekatan dengan sel udara mastoid di fossa posterior. (Kanan) CT tulang aksial pada pasien yang sama menunjukka kekeruhan total dari telinga tengah dan mastoid. Perhatikan dinding tulang medial mastoid yang utuh dan tidak adanya mastoiditis confluent. Vena emissary dapat memberikan rute penyebaran dari otomastoiditis akut ke kompartemen intrakranial. Epidural abses yang ditemukan pada pembedahan.[26]

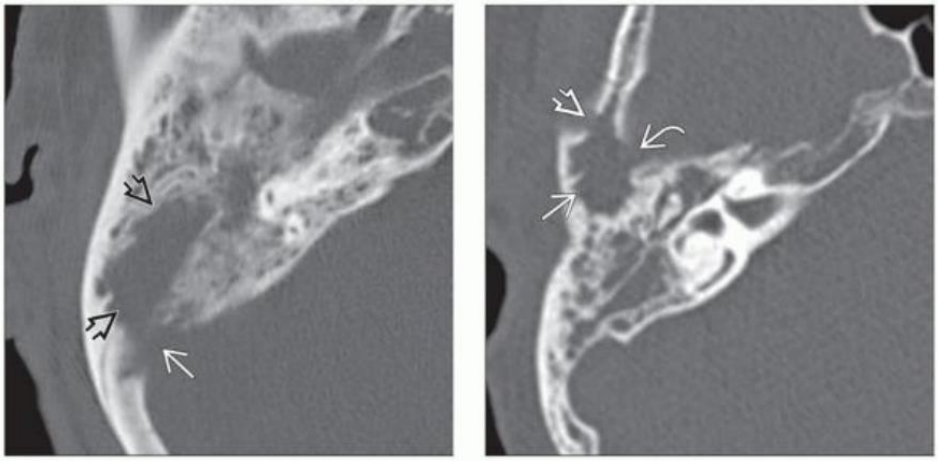


(Kiri) Axial T1 + C MRI pada orang dewasa dengan penurunan kesadaran dan demam menunjukkan cincin bilobed yang meningkat post-contrast abses lobus temporal, bersama dengan peningkatan meningeal menunjukkan meningitis sekunder. (Kanan) MR koronal T1 + C pada pasien yang sama amenunjukkan otomastoiditis akut dengan area suppurasi yang confluent. Hubungan langsung antara abses mastoid dengan abses lobus temporal terlihat disertai dengan meningitist.[26]

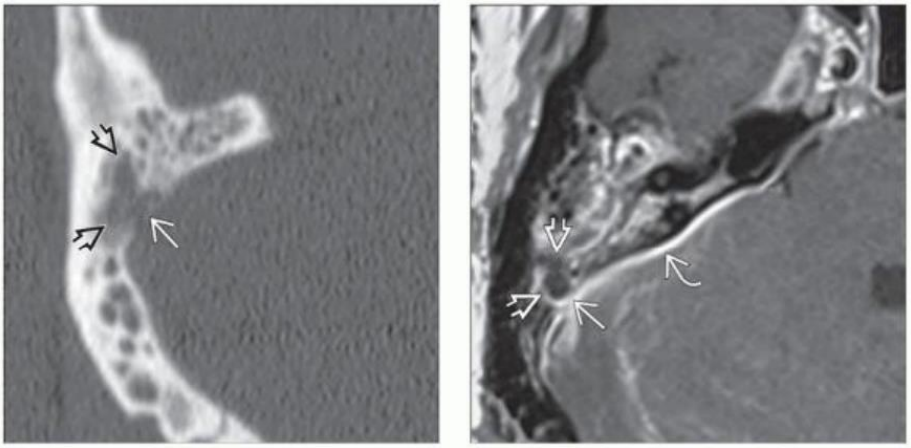


(Kiri) CT tulang aksial pada anak dengan nyeri tekan mastoid, demam, dan massa leher posterior menunjukkan n kerusakan trabekula pada mastoid kanan, menunjukkan otomastoiditis confluent akut. Perhatikan juga korteks mastoid lateral fokal dehisensi. (Kanan) CECT aksial pada pasien yang sama menunjukkan abses trans-spasial besar di posteroinferior ujung mastoid akibat penyebarani nfeksi dari otomastoiditis konfluen akut. Celah di mastoid lateral korteks memberikan jalan keluar bagi nanah.[26]

Otitis media Akut dengan coalescent otomastoiditis

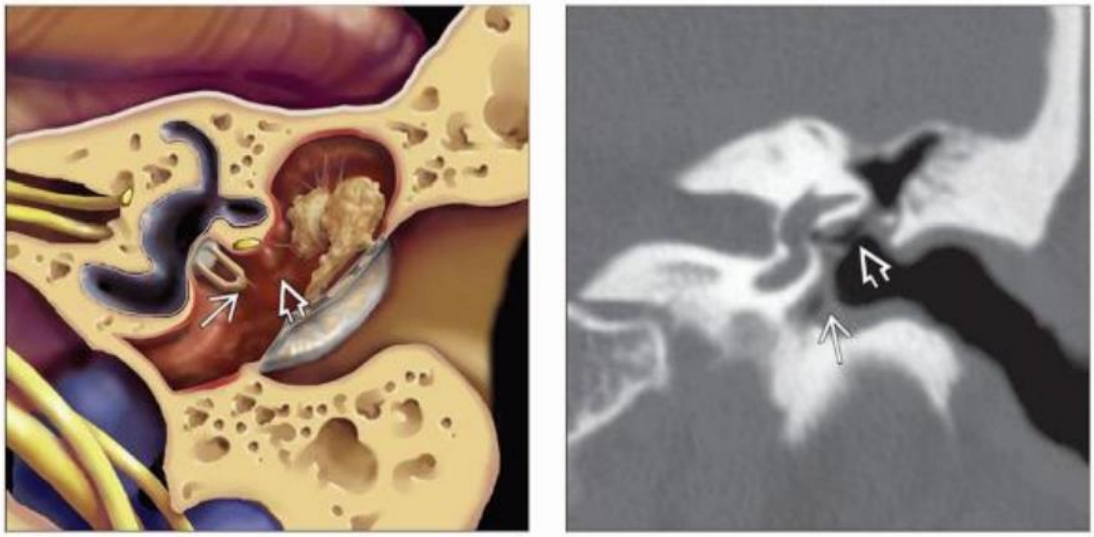


(Kiri) CT tulang telinga kanan aksial pada pasien dengan otalgia dan demam menunjukkan area yang luas dari sel udara mastoid yang coalescent disertai dehiscence korteks mastoid medial terkait menempatkan pasien pada risiko abses epidural atau thrombosis sinus sigmoid. (Kanan) CT tulang telinga kanan aksial menunjukkan opasifikasi pada telinga tengah dan sel udara mastoid. Di anterolateral ada area focal coalesensi disertai dengan dehiscence kortikal lateral dan medial. Pre-auricular maupun epidural abses dapat terjadi.[26]

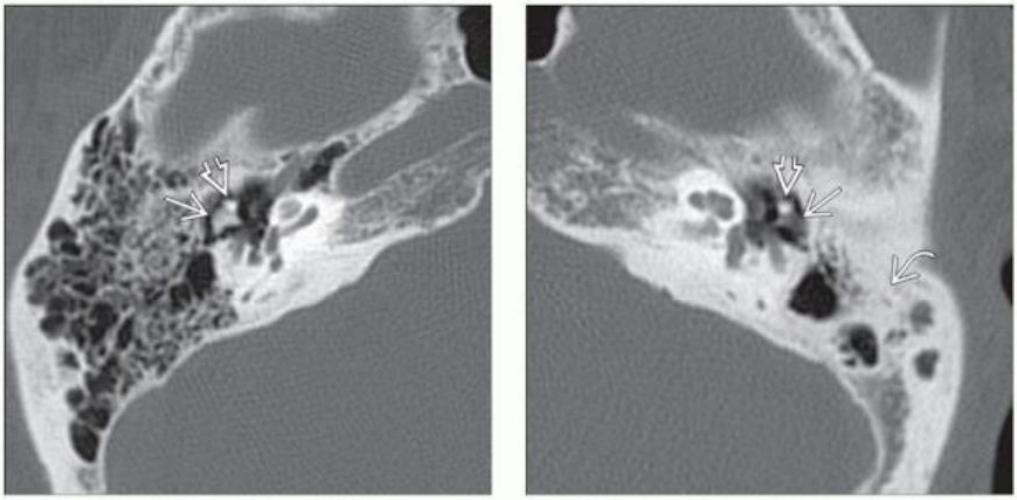


(Kiri) CT tulang koronal mastoid posterior memperlihatkan opasifikasi sel udara mastoid yang difus dari otomastoiditis. Area confluent dini terlihat disertai dehiscence dinding kortikal mastoid medial. (Kanan) Aksial T1WI C+ MR pada pasien yang sama menunjukkan peningkatan heterogen dari telinga tengah & mastoid. Area fokus mastoid dehiscence trabecular pada CT terlihat sebagai sinyal nanah yang rendah. Dehiscence kortikal pada area medial. Penyangatan meninges menunjukkan adanya meningitis.[26]

Otomastoiditis kronik dengan erosi tulang pendengaran

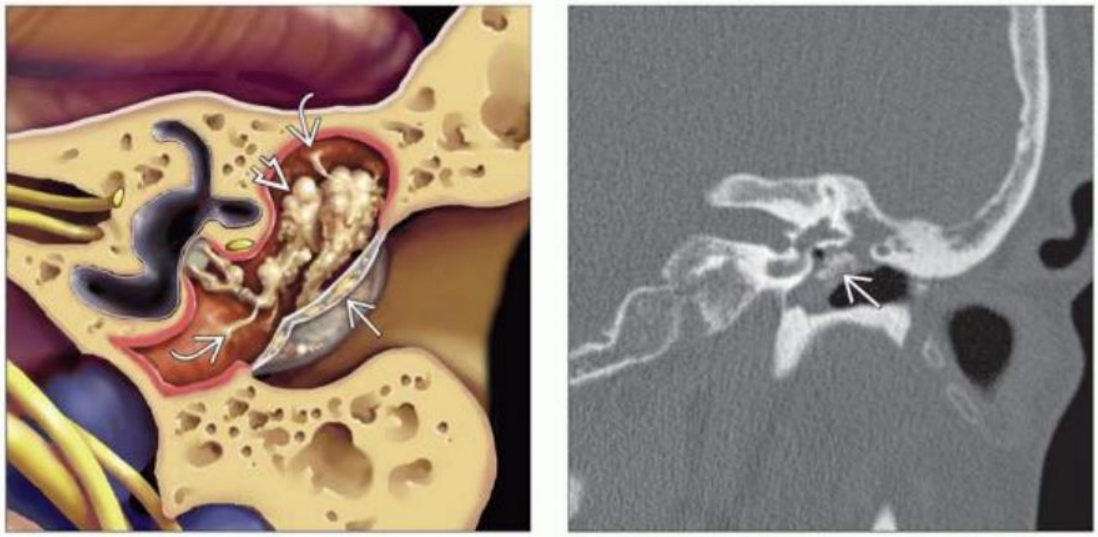


(Kiri) Gambar koronal telinga kiri menunjukkan erosi tulang pendengaran pasca inflamasi dari prosesus longus incus dan hub stapes. Perhatikan perubahan timpanosklerosis membran timpani dan tulang-tulang pendengaran yang tersisa. (Kanan) CT tulang koronal memperlihatkan retraksi membran timpani yang menebal dengan demineralisasi prosesus longus incus. Tampak lesi jaringan lunak di telinga tengah disertai debris inflamasi.[26]

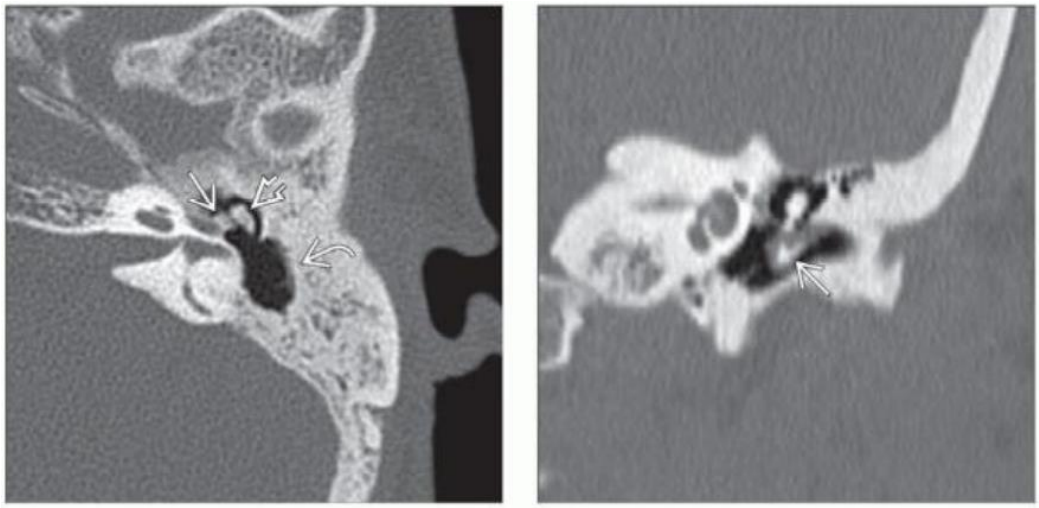


(Kiri) CT tulang aksial menunjukkan prosessus brevis incus kanan yang normal dan kepala malleus .Perhatikan mastoid yang terpneumatisasi dengan baik. (Kanan) CT tulang aksial telinga kiri pada pasien yang sama dengan riwayat otitis media kronis menunjukkan deosifikasi prosesus brevis incus kiri. Kepala malleus memiliki densitas dan ukuran yang normal. Mastoid mengalami underpneumatized dari otomastoiditis selama pembentukan mastoid.[26]

Otomastoiditis kronik dengan tympanosclerosis

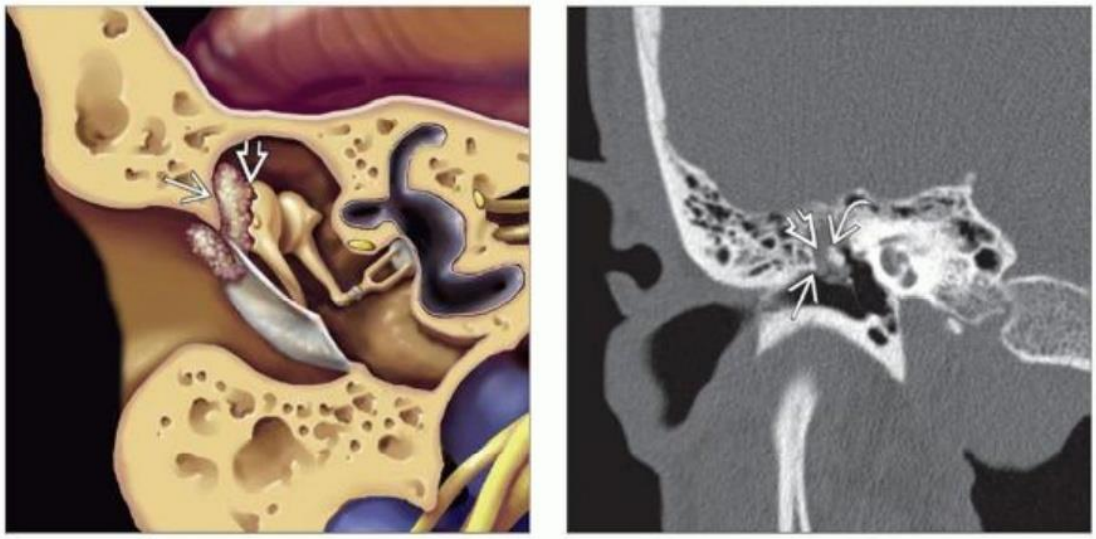


(Kiri) Gambar koronal menunjukkan timpanosklerosisberat pada otomastoiditis kronis. Pasca inflamasi kalsifikasi dapat terlihat pada membran timpani, tulang-tulang pendengaran, dan ligament tulang-tulang pendengaran. (Kanan) CT tulang koronal memperlihatkan ossicles sebagai "fuzzy ball". Penampilan ini disebabkan oleh focus deposit kalsifikasi timpanosklerotik pada permukaan tulang-tulang telinga tengah.[26]

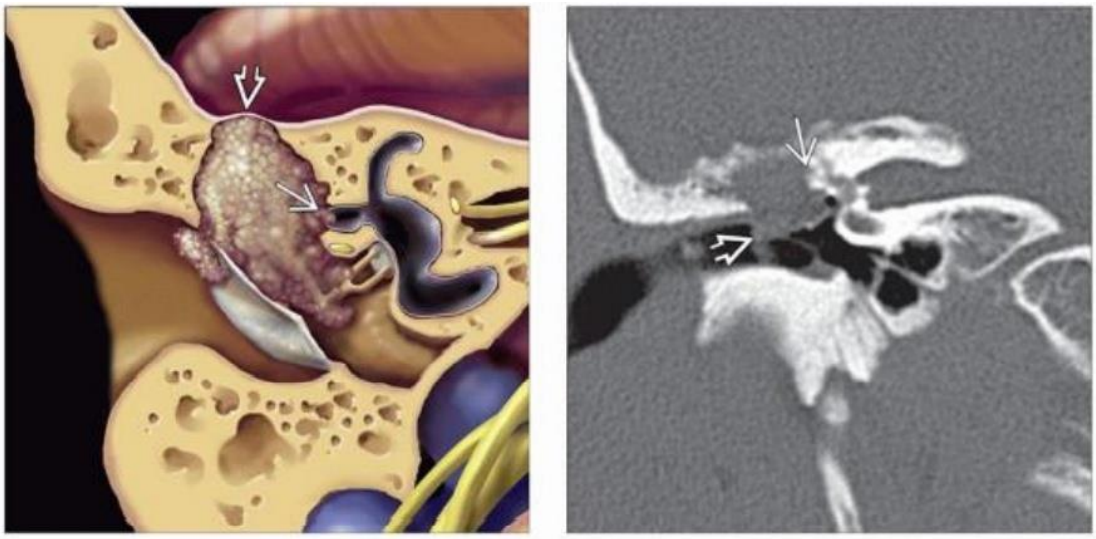


(Kiri) CT tulang aksial menunjukkan area focus timpanosklerosis ossifikasi tepat di medial ossicles di dinding medial epitimpanum. Perhatikan juga artikulasio malleus-incus yang menyatu, dan mastoid yang hanya mengandung rongga antral. (Kanan) CT tulang koronal menunjukkan penebalan membran timpani dengan fokus linier kalsifikasi sepanjang permukaannya. Kalsifikasi timpanosklerotik dapat mengenaii ligament, tendon, ossicles, atau membrana timpani seperti dalam kasus ini.[26]

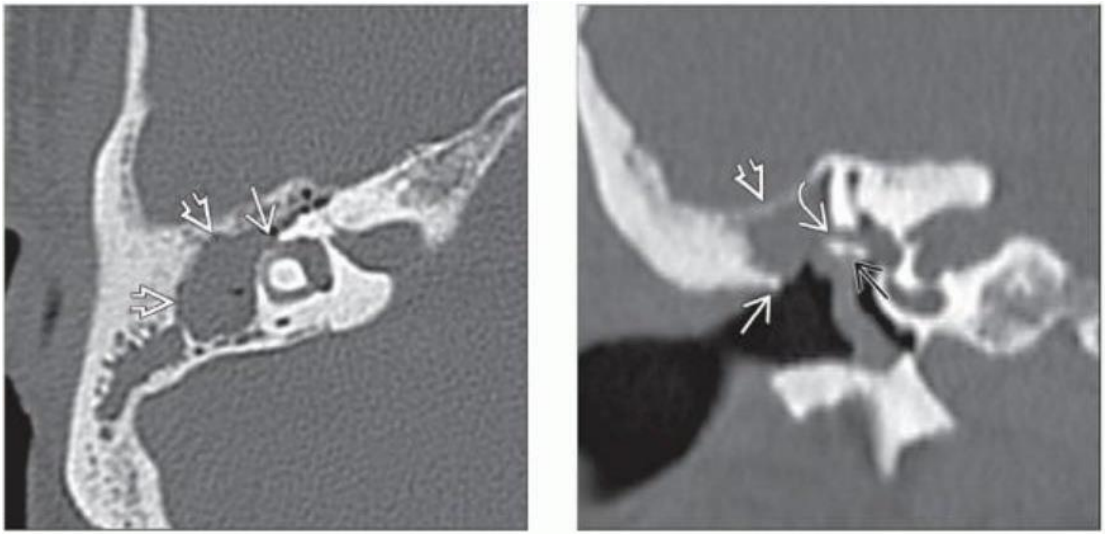
Pars Flaccida Cholesteatoma



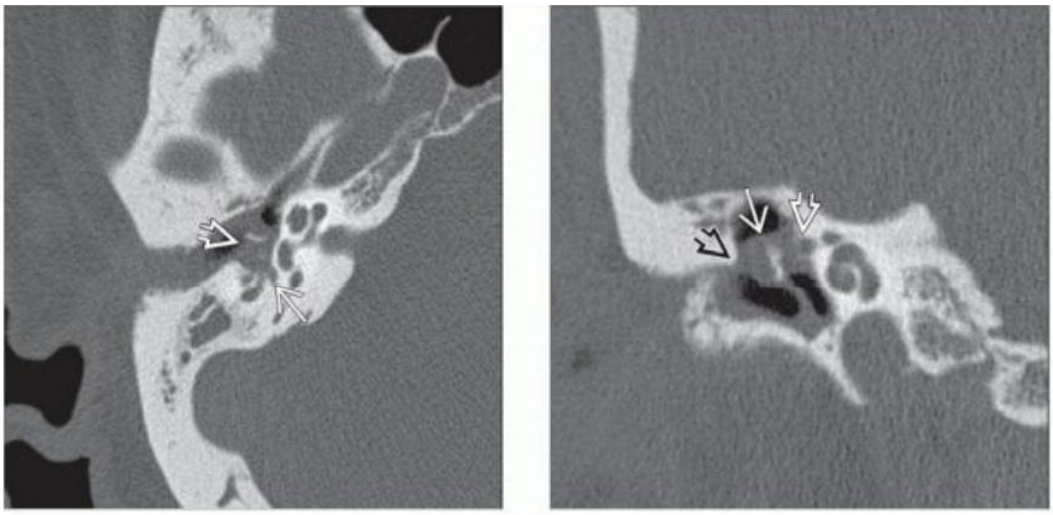
(Kiri) Gambar koronal menunjukkan kolesteatoma kecil yang berasal dari bagian pars flaccid membran timpani dengan mengisi Prussak space. Erosi ringan dengan perpindahan medial kepala maleus terlihatr. (Kanan) CT Koronal tulang memperlihatkan kolesteatoma kecil pada pars flaccid mengisi Prussak space dan scutum yang tumpul dan. kaput malleus sedikit erosi dan tergeser ke medial.[26]



(Kiri) Gambar koronal menunjukkan kolesteatoma pars flaccida yang besar. Komplikasi termasuk erosi ossicles,dan dehiscence kanalis semisirkularis lateral ,& scalloping tegmen tympani. (Kanan) CT tulang koronal menunjukkan kolesteatoma pars flaccid besar sebagai massa jaringan lunak di dalam telinga tengah kanan dan rongga mastoid. Ada fistulasi dengan kanalis semisirkularis lateral. Kolesteatoma juga terlihat menonjol melalui membrane tympani yang perforasi ke canalis acusticus externus.[26]

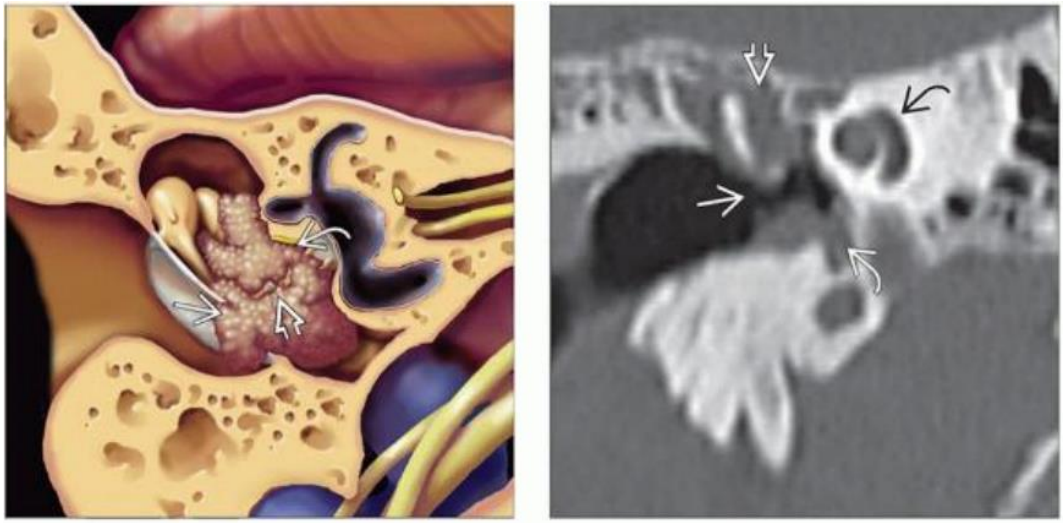


(Kiri) CT tulang aksial menunjukkan kolesteatoma besar di rongga telinga tengah dengan dinding scalloping. Ada erosi bagian anterior kanalis semisirkularis lateral dengan fistula. (Kanan) CT tulang koronal dari pasien yang sama menunjukkan bahwa tegmen timpani menipis dan kanalis semisirkularis lateral dehiscence. Erosi saucerisasi kanal CN7 pars timpani dan penumpulan scutum juga ada[26]

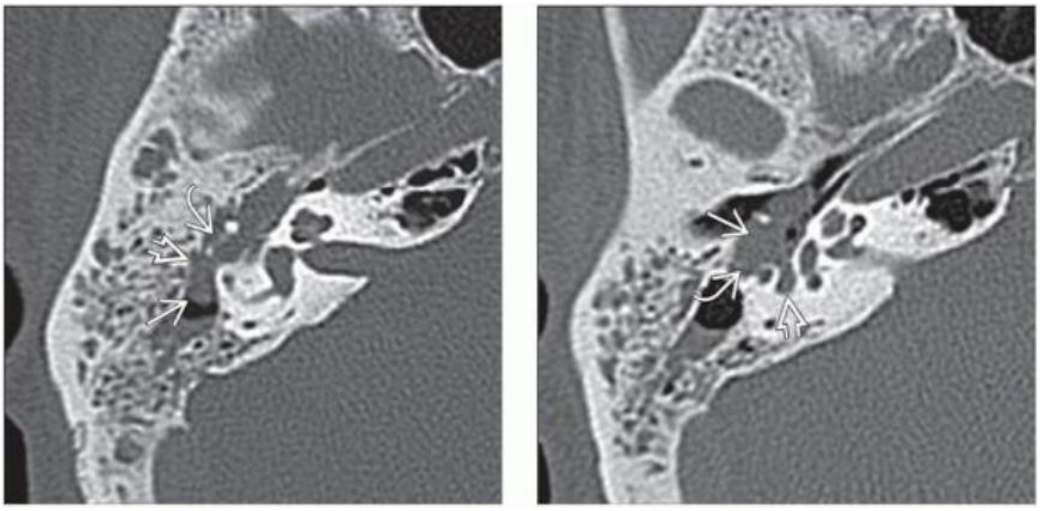


(Kiri) CT tulang aksial menunjukkan massa jaringan lunak yang mengisi rongga timpani. Jaringan lunak meluas ke sinus tympani , yang merupakan checkpoint penting karena merupakna titik buta bedah dan sering menjadi tempat kekambuhan. Prosessus longus incus erosi (tidakditampilkan). (Kanan) CT tulang koronal pada pasien yang sama menunjukkan epitimpani kolesteatoma dengan scutum tumpul. Malleus tergeser ke medial dan erosi sebagian. Lesi berdekatan tapi tidak erosi di anterior CN7 pars tympan[26]

Pars Tensa Cholesteatoma



(Kiri) Gambar koronal pars tensa cholesteatoma (PTC) menunjukkan kolesteatoma meluas ke lateral melalui ruptur TM inferior. PTC telinga tengah mengerosi tulang-tulang pendengaran, menginvasi & meratakan kanalis CN7pars timpani, dan terutama di area medial ossicles. (Kanan) CT tulang koronal pada level cochlea menunjukkan pars tensa TM perforasi. Aspek paling anterior dari PTC terlihat di atas dan di bawah perforasi pada ronggatelinga tengah.[26]



(Kiri) CT tulang aksial pada pasien yang sama menunjukkan PTC erosi prosesus brevis incus dan meluas melalui aditus ad antrum ke antrum mastoid. (Kanan) CT tulang aksial level oval window memperlihatkan erosi incus dan hub stapes dengan invasi resessus CN7 dan sinus timpani. Keterlibatan sinus timpani harus dilaporkan, karena area ini tidak dapatdilihat oleh ahli bedah dan kekambuhan dapat terjadi jika tidak diperhatikan.[26]

DIAGNOSA BANDING

- Acquired cholesteatoma
- Apical petrosis
- Temporl bone Langerhans histiocytosis
- Temporal bone rhabdomyosarcoma

KESIMPULAN

Otitis media adalah spektrum penyakit yang berhubungan dengan infeksi pada telinga tengah. Riwayat infeksi saluran pernapasan sebelumnya dapa menyebabkan obstruksi saluran tuba, terhambatnya drainase cairan, dan kolonisasi pathogen di telinga tengah. Umumnya yang paling sering penyebabnya adalah virus influenza, parainfluenza, rinovirus, adenovirus, enterovirus. Bakteri patogen yang paling sering menyebabkan otitis media akut adalah *Streptococcus pneumoniae* dan *Haemophilus influenza*, diikuti oleh *Moraxella catarrhalis/* Manifestasi klinik yang didapatkan dari otitis media akut dapat berupa otalgia dan penurunan pendengaran. Pemeriksaan membran timpani dengan otomikroskopi atau otoskopi adalah kunci diagnosis yang tepat.

Dalam penegakan diagnosis otitis media ini didasarkan atas hasil pemeriksaaan klinis (anamnesis dan pemeriksaan otologic) serta untuk mengetahui ada tidaknya komplikasi melalu pemeriksaan radiologik (foto polos, CT Scan dan MRI mastoid). Imaging yang terbaik untuk menilai penyakit kroniktelinga tengah dan tulang temporal (mastoid) termasuk kolesteatoma adalah dengan CT scan karena mampu memperlihatkan destruksi tulang.

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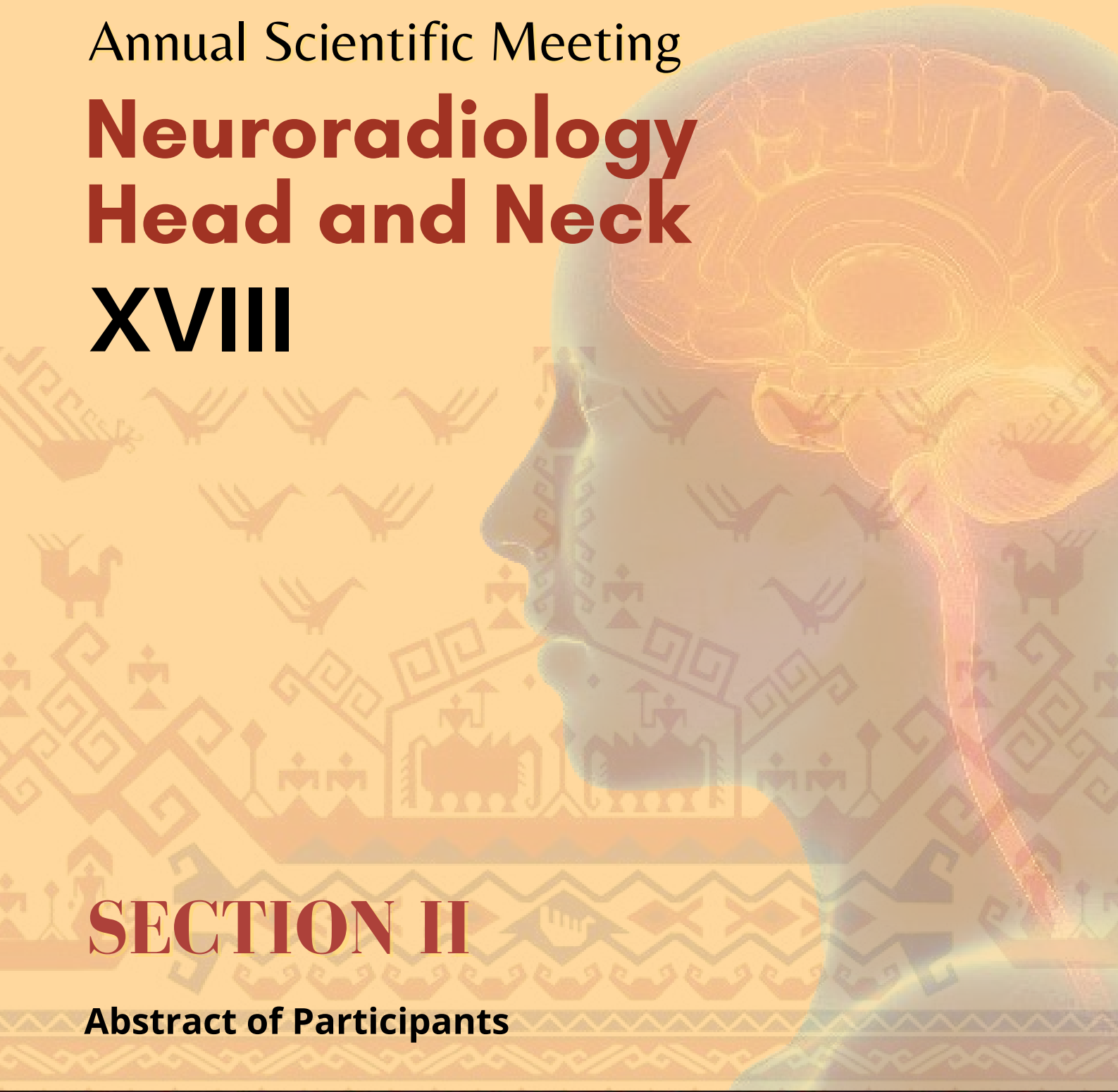

SECTION II

Abstract of Participants

Brain Abscess with Features Resembling Diffuse Astrocytoma in MRI: A Case Report

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ABSTRACT

BACKGROUND: Brain abscess is a focal area of necrosis starting in an area of cerebritis surrounded by a membrane. MRI is usually able to convincingly make the diagnosis, distinguishing abscesses from other ring-enhancing lesions. Diffuse astrocytoma is an infiltrating type of glioma (WHO grade II), which even with histopathology is difficult to diagnose. The presence of gliosis often leads to misdiagnosis of abscess as a diffuse astrocytoma. MRI is the cornerstone for diagnoses and follow-up of brain gliomas. Differentiation between these entities is of utmost importance to determine the indications and urgency of intervention and a suitable management plan

OBJECTIVE: To report a case of brain abscess with features resembling diffuse astrocytoma in MRI

METHODS: The data was collected from medical records, appropriate imaging and histopathology archives

RESULTS: The patient complained of headache and blurred vision which was getting worse. MRI revealed multiple lesions in left occipital lobe, with iso-hypointense signal in T1W, iso-hyperintense in T2W, hyperintense on FLAIR, the largest measured 1.8 x 1.9 x 1.6 cm. The lesions showed restricted diffusion in DWI, ring enhancement after contrast administration, accompanied by large vasogenic edema that extends to posterior horn of the left lateral ventricle. Characteristically, MR spectroscopy showed increase in lipid-lactate and normal ratio of Choline-NAA. Radiologically, patient was assessed as multiple brain abscess. Histologic result was a diffuse astrocytoma, however after a craniotomy, cerebral abscesses were found

CONCLUSION: Although the histopathologic characteristics of cerebral abscesses and diffuse astrocytoma may sometimes be similar but MR imaging, diffusion and spectroscopy enables distinction between the two

***Keywords**: Brain abscess, Diffuse astrocytoma, MRI*

Spinal cord neurotoxoplasmosis in immunocompetent patient: A Case Report

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ABSTRACT

BACKGROUND : The brain has been the most common site for toxoplasma infections in patients with HIV but appears to be an uncommon cause of spinal cord disease. The incidence of myelopathy in patients with HIV may be as high as 20%, with 50% of the cases reported post-mortem. Spinal cord toxoplasmosis can present as acute onset weakness in both lower limbs associated with sensory and bladder dysfunction. Diagnosis established by radiology imaging MRI gadolinium contrast and laboratory positive serum *Toxoplasma gondii* IgG antibodies.

OBJECTIVE : To report a rare case of toxoplasmosis in the spinal cord of an immunocompetent patient

METHOD: The case report is documented from a 46 years-old man who was referred to the radiology department with progressive sub-acute spastic paraparesis. Laboratory results showed strong avidity toxoplasmosis, positive IgG toxoplasma and negative for HIV infection. An MRI gadolinium contrast examination was performed.

RESULT: MRI showed an intradural intramedullary pathological lesion level at first thoracal vertebrae, with well-defined border and irregular edges measuring 0.8 x 1.3 x 1.2 cm^3. It showed hypointense signal in T1W, hyperintense in T2W and T2W Dixon water-only, with target sign and ring enhancement after gadolinium contrast administration. This finding was typical of neurotoxoplasmosis in spinal cord.

CONCLUSION: Toxoplasmosis in spinal cord is an uncommon case of neurotoxoplasmosis, which mostly in the brain. Our case demonstrates appearance of neurotoxoplasmosis in spinal cord of an immunocompetent patient, which is interesting because it is usually found in immunocompromised patients.

***Keywords**: Neurotoxoplasmosis, spinal cord, immunocompetent, MRI*

CT and MRI Findings of Cerebral Tuberculoma: What Radiologist Should Know

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ABSTRACT

BACKGROUND: Tuberculomas or tuberculous granulomas are well defined focal masses that result from *Mycobacterium tuberculosis* infection and are one of the more severe morphological forms of tuberculosis. Tuberculomas most commonly occur in the brain.

OBJECTIVE: To report radiology imaging of cerebral tuberculoma in Head CT and MRI.

METHOD: Case Report: A 47 years old woman, had been suffering weakness of the limbs, especially the right one, approximately for about one year. Patient have difficulty communicating, and often fall asleep. Patient had taken oral anti tuberculosis for three months.

RESULT: The brain MRI with contrast administration on April 21nd 2021, had result: Multiple pathological lesions in the parenchyma of the bilateral frontal lobes, bilateral parietal lobes, left corona radiata, left anterior crus of the internal capsule to the external capsule, with the largest size in the left parietal lobe on the parasagittal aspect of 3.53 x 1.62 x 2.63 cm, which gave an inhomogeneous signal, hypo-isointense on T1W, hyper-hypointense on T2W and FLAIR, restricted on DWI, and heterogeneous enhancement post-contrast. Accompanied by perifocal vasogenic edema around it and an area of central necrosis in some lesions; leads to multiple cerebral tuberculomas with perifocal vasogenic edema around it. The following head MSCT with contrast administration on May 27th 2021, had result: Multiple hypo-isodense inhomogeneous unenhanced lesions were seen in bilateral frontal lobes, left parietal lobe, left temporal, right anterior crus of the internal capsule, with images of extensive perifocal edema around it.

CONCLUSION: CT and MRI with contrast administration have important role to diagnose cerebral tuberculoma. MRI findings of tuberculomas are varied depending on its three stages of maturation: noncaseating, caseating with a solid center and caseating with a liquefied center.

Keyword: *Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Cerebral Tuberculoma*

Retropharyngeal Abscess with Extensive Mediastinal Involvement: A Case Report

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ABSTRACT

BACKGROUND: Retropharyngeal abscess (RPA) is an uncommon but life-threatening and dangerous condition in adults. RPA is more common in males than in females, with a preponderance of 53–55%. RPA can lead to airway obstruction, septic shock, rupture of the abscess into the airway resulting in aspiration pneumonia or asphyxia, mediastinitis, carotid rupture, and suppurative thrombophlebitis of the internal jugular veins.

OBJECTIVE: To report a case of Retropharyngeal abscess and its features on CT scan imaging.

METHODS: The data were collected from medical records and appropriate imaging archives.

RESULTS: A 58 years-old man with shortness of breath since 3 days before admission. The patient also complained of upper tooth pain and swelling since 14 days ago. Contrast-enhanced CT showed lesions along the retropharyngeal with isodense signal mixed with air. The lesion has a pre-contrast density of 45 Hounsfield units and a post-contrast density of 90 Hounsfield units. It extended to the danger space, thoracic aperture, and superior mediastinum.

CONCLUSION: CT is excellent at evaluating the neck which is an important factor when imaging patients with potential narrowing of the airway. A true abscess will usually have a peripherally enhancing rim with a centrally hypodense collection, expansion of the retropharyngeal space, and may contain locules of gas. Deep neck space infection can pose an immediate life-threatening emergency, with the potential for airway compromise and other catastrophic complications. In rare cases, the cystic degeneration of cervical metastases may mimic deep neck abscesses on CT images. A routine biopsy of the tissue must be performed during surgical drainage.

Keywords: *Retropharyngeal (RPA), Abscess, Computed Tomography (CT), Mediastinal extension*

Paraplegia Caused by Tuberculous Spondylitis : A Case Report

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ABSTRACT

BACKGROUND: TB(Tuberculous) is one of the top 10 causes of death and the leading cause of infectious agents. In 2017, TB caused an estimated 1.3 million deaths (range, 1.2-1.4 million) among HIV negative persons and there were approximately 300,000 TB deaths (range, 266,000-335,000) among HIV positive persons. There are an estimated 10 million new TB cases (range, 9-11 million) equivalent to 133 cases (range, 120-148) per 100,000 population. Spinal tuberculosis, the most common form of skeletal involvement. This article reports an interesting case of Tuberculous spondylitis with osteodestruction paravertebral abses and gibbus deformity.

OBJECTIVE: To find out the specific picture of TB spondylitis cases with MRI modalities

METHOD: A case of 21-year-old female with tuberculous spondylitis who have no history of HIV, underwent a MRI thoracal non contrast.

RESULT: MRI revealed - tuberculous spondylitis in VTh 12 - VL 1 with osteodestruction in VL 1 and paravertebral abscess in VTh 12 - VL 1 causing severe spinal canal stenosis and severe bilateral foraminal stenosis with gibbus angular deformity. These findings MRI results found TB spondylitis which causes extradural damage that supports the patient's complaint of pain in the spine accompanied by complaints of difficulty walking

CONCLUSION: Tuberculous spondylitis, refers to vertebral body osteomyelitis and intervertebral discitis by tuberculosis. The spine is the most frequent location of musculoskeletal tuberculosis, and commonly related symptoms are back pain and lower limb weakness. MRI imaging plays a crucial role in the diagnosis of tuberculous spondylitis

Keyword(s): tuberculous spondylitis, burst fracture, MRI thoracal

Paravertebral Abscess Mimicking Mediastinal Mass in Tuberculous Spondylitis Patient

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ABSTRACT

INTRODUCTION: Tuberculosis is still one of the most important health problems in the world.[1,2] Globally, 7.1 million people with TB were reported to have been newly diagnosed in 2019.[3] Tuberculosis of the spine accounts for more than 50% of musculoskeletal tuberculosis.[5] The purpose is to report a paravertebral abscess mimicking mediastinal mass in tuberculous spondylitis patient.

REPORT: A 21-year-old man was referred with bilateral lower extremities weakness accompanied by numbness that gradually could not be moved. Previously he had fever, cough, shortness of breath, and night sweats. Clinical evaluation there was anemic conjunctiva, lymphadenopathy at regio colli, mobile, 3 cm in diameter, and crackles in the lungs. No mycobacterial tuberculosis was found on sputum smear examination. Chest x-ray demonstrated a well-defined homogenous opacity with obtuse angle in bilateral paratracheal, suspected as mediastinal mass and non-homogenous consolidation in upper to lower bilateral lung associated with left pleural effusion and there was no vertebral deformity in thoracolumbal x-ray. Cervicothoracolumbal magnetic resonance imaging (MRI) revealed multiple abcesses in the left paravertebral region at the level of Thoracal 1 to 8 that extends to the right paravertebral region at the level of Thoracal 1 to 7.

CONCLUSION: In this report, we presented a case of tuberculous spondylitis with a paravertebral abscess initially thought to be a mediastinal mass.

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Rare Case of Tuberculous Meningitis with Intracerebral and Intraventricular Tuberculoma, Tuberculous Abscess, Obstructive Hydrocephalus, and Transependymal Edema

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ABSTRACT

BACKGROUND: Central nervous system (CNS) involvement of tuberculosis is seen in approximately 5-10% of patients with mortality rate up to 20%.[1-4] The most common manifestations of CNS tuberculosis are meningitis, tuberculoma, cerebritis, and cerebral abscess.[2, 5] The prevalence of intracerebral tuberculoma, interventricular tuberculoma, and cerebral tuberculous abscess are rare in children.[4, 6] As far as we know, there was no case of tuberculous meningitis with both intracerebral and intraventricular tuberculomas, and tuberculous abscess in one patient was reported.

REPORT: A 13 years old girl with decreased consciousness was referred to our hospital. The patient looked drowsy since two weeks earlier. The patient had tonic-clonic seizures with a duration of less than five minutes accompanied by fever 7 days before admission. The patient was unresponsive after the seizure. The patient was on therapy for lung tuberculosis since 5 months before the onset of symptoms. On admission, the patient underwent head CT with contrast that showed there was a large cystic lesion with rim enhancement in the pineal region with extension to the midbrain and obstructed aqueduct of Sylvii, consistent with cerebral abscess, and cause obstructive hydrocephalus with transependymal edema. There was also multiple lesion with rim enhancement in the cortical region of left temporal lobe and anterior wall of fourth ventricle, suggestive of tuberculoma, and meningeal enhancement in temporoparietal region. The patient underwent VP shunt placement to reduce intracranial pressure. The patient also underwent head MRI which confirmed the diagnosis of tuberculous meningitis, multiple intracerebral and intraventricular tuberculoma, and tuberculous abscess in pineal region and midbrain. The obstructive hydrocephalus and transependymal edema was resolved.

CONCLUSION: In this report, we presented a rare case of tuberculous meningitis with multiple intracerebral and intraventricular tuberculoma and tuberculous abscess in the pineal region with extension to the midbrain which cause obstructive hydrocephalus and transependymal edema.

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A Case Report : Radiation-Induced Brachial Plexopathy, A Challenge in Imaging Diagnostic

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ABSTRACT

BACKGROUND : Radiation-induced brachial plexopathy (RIBP) is often seen in patients treated for lymphoma, breast and lung cancer. Its incidence is correlated with the irradiation technique, which have shown a mean incidence 1.8-2.9% per year for those who have undergone radiation therapy in brachial plexus region. This process causes ischemia-hypoxia and subsequent axonal damage and demyelination. This damage generally occurs 5-30 months after completion of radiation therapy, with peak at 10-20 months, with symptoms paresthesia, hyperthesias, pain and weakness. It is challenging for radiologist to distinguish that between metastatic infiltration and radiation-induced plexopathy. Magnetic Resonance Imaging (MRI), with its superior soft tissue discrimination and multi-planar imaging capabilities, has a special value to help differentiate them.

OBJECTIVE : This is a case report to describe presentations in RIBP with MRI in a breast cancer patient.

METHOD : A 50-years old female with breast carcinoma, who underwent mastectomy surgery in 2015 and received chemotherapy after that. Then, she received 40 times radiation therapy. She presents with paresthesia, hyperesthesia, and pain in left upper extremity since 6 months after radiation therapy, getting worse after 10 to 12 months. She has history of anterior dislocation in left shoulder.

RESULT : MRI of left brachial plexus revealed irregularity, increased thickness and hyperintense in post ganglionic C.6/C.7/C.8 segment with soft tissue edema perineural, with fibrotic changes in left subcapsular muscle, which represent RIBP. There are also multiple conglomerated lymphadenopathy in level 3 left axillary, supraclavicular, and colic region, which highly suspicious of metastatic lymph node. She is treated with medication to control pain and physical therapy to maintain muscle strength.

CONCLUSION : Evaluation of the RIBP presents a great challenge to the clinician and radiologist. it is important for the radiologist to be familiar with its MR imaging characteristics. Specific clinical and MR imaging features that can help distinguish particular entities.

Brain Abscess in Patients with Acquired Immunodeficiency Syndrome : A Case Series

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ABSTRACT

BACKGROUND : A brain abscess is an intraparenchymal collection of pus with incidence approximately 8% of intra-cranial masses in developing countries and 1–2% in the western countries. They begin as localized areas of cerebritis in the parenchyma and evolve into collections of pus enclosed by a well-vascularized capsule. HIV patients have a decrease of CD4 below the critical level so the patients become very susceptible to infection. One manifestation that occurs in HIV/AIDS patients is brain abscess. The prevalence of brain abscess in HIV/AIDS patients is higher, estimated to reach 1 : 10,000 patients or about 1500-2500 events per year. It is a potentially life-threatening condition requiring prompt radiological identification and rapid treatment.

OBJECTIVE : To report a case series of brain abcess in patients with acquired immunodeficiency syndrome.

METHOD : The data was collected from medical records and appropriate imaging archieves

RESULT : Three patients, two male and one female, age > 35 years old complained of headache, nausea, vomiting and communication disorders. Based on laboratory results, the patients have been diagnosed with HIV/AIDS. Brain MR showed multiple pathological lesions in the brain that were hypointense in T1W , hyperintense in T2W and FLAIR, diffusion-restricted in DWI and ring enhancement after contrast administration, accompanied by vasogenic perifocal edema.

CONCLUSION : Magnetic resonance (MR) imaging is more sensitive than CT in the detection of brain abscess and its associated complications because it has greater sensitivity to changes in tissue water content, resulting in greater contrast between edematous brain and normal brain during the early stages of cerebritis and abscess formation. Restricted diffusion within a ring-enhancing mass is typical but not pathognomonic of a brain abscess.

Keywords: *Brain abscess, HIV/AIDS, MRI*

Tuberculoma, A Rare Case of CNS TB : A Case Report

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ABSTRACT

BACKGROUND : Intracranial tuberculoma is one of the rare central nervous system manifestations of Mycobacterium tuberculosis (MTB), seen in only 1% of tuberculosis patients. It can manifest as single or multiple lesions, most commonly located in the frontal and parietal lobes. Central nervous system (CNS) involvement is one of the most serious forms of mycobacterium tuberculosis (MTB) infection.

OBJECTIVE : This articles report feature of CNS tuberculoma in tuberculosis patient.

METHOD : A thorough data collection was done from medical records.

RESULT : An 18 years-old female presented to the hospital with headache, nausea, vomiting, cough and fever since a month ago. Chest X-ray showed opacities in bilateral lung resembling snowstorm appearance with air bronchogram. Laboratory result showed positive IGRA test and CSF leucocyte count which supported TB diagnosis. A week after treatment initialization, patient underwent brain MRI which showed multiple ring-enhancing lesions in bilateral cerebral, cerebellar and cerebellar pontine. The lesions exhibited isointense signal in T1-Weighted, hypointense signal in T2-Weighted and T2-FLAIR, and restricted signal in DWI. The patient got firstline TB regiment and streptomycine injection.

DISCUSSION : Intracranial tuberculoma is one manifestation of CNS tuberculosis. Tuberculosis is an infectious disease that mainly involves pulmonary system, but in a certain condition, it can go extrapulmonary. CNS involvement is uncommon (only 5-10% in a patient with pulmonary TB), but need awareness as it relates to high morbidity and mortality. Tuberculoma should be considered in TB patient with altered mental status, focal neurological signs and increased ICP signs and symptoms. To support the diagnosis, contrast-enhanced head CT or MRI can be performed.

Keywords : *CNS TB, Tuberculoma, MRI, Extrapulmonary*

Endemic in Bali: Diffuse Cystisercosis – Human Immunodeficiency Virus

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ABSTRACT

BACKGROUND : Neurocysticercosis (NCC) is the most common parasitic disease of the central nervous system. The infection caused by the larval form of the tapeworm *Taenia solium*, is the most common parasitic disease of the central nervous system and the most common cause of acquired epilepsy worldwide. According to Escobar classification, NCC has four stages: vessicullar, colloidal vessicullar, granular nodular, and calcified nodular. Immunocompromised patient are unable to remove the parasite due to impaired humoral immunity. CT and MRI are useful in anatomical localization of the cyst. MRI is more sensitive than CT, as it not only identifies scolex and live cyst in cisternal spaces and ventricles but also identifies the response to treatment

OBJECTIVE : Knowing the structural abnormalities of the brain that causing seizure and unconsciousness, which can be detected through an MRI examination

METHOD : A 14 years old female teen, with history of seizure with fever, unconsciousness and HIV on treatment for 1 month

RESULT : Advance MRI showed, multiple intraaxial supratentorial and infratentorial round lessions, well-defined on cortico-medullary junction and white matter fronto-parieto-occipital-temporal bilateral lobes, corpus callosum, bilateral periventricular, bilateral basal ganglia, pons, midbrain and bilateral cerebellum of varying size with surrounding perifocal edema, with features iso-hyperintense on T1WI, hyperintense on T2WI and FLAIR, no contrast enhancement on contrast. In DWI/ADC, showed restricted diffusion and no blooming artefact on SWI/Phase Image.

CONCLUSION : MRI is the superior for diagnosing with seizure, staging, and treatment response.

***Key words**: Neurocysticercosis, Stages, MRI, Immunocompromised*

Atypical Presentation in Multilevel Tuberculosis Spondylitis Involving Cervical and Upper Thoracal Spine

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ABSTRACT

BACKGROUND: Tuberculosis of spine is a form of extrapulmonary tuberculosis manifestation and accounts for more than 50% of all cases of skeletal tuberculosis. It usually affects the lower thoracic and upper lumbar levels of the spine. Involvement of cervical spine is rare, comprising 3-5% of cases of tuberculosis, however, it can cause serious morbidity, including permanent neurologic deficits and severe deformities.

OBJECTIVE: To report clinical manifestations and radiological findings of a patient with cervical and upper thoracal involvement in multilevel tuberculosis spondylitis.

METHOD: The data was collected from medical records, appropriate imaging archives, laboratory, and histopathology.

RESULT: A 22-year-old woman came with prolonged neck pain and paraparesis. The pain started 5 months before current hospital admission, worsened with compression when laying down, and radiates to both upper arms. No previous medical illness reported. Previous MRI of the spine performed at another hospital showed multiple extradural masses of 1st and 10th thoracic vertebrae, canal stenosis of 1st and 2nd thoracic vertebra, with suspicion of metastases or tuberculosis. Non-enhanced cervical CT revealed paravertebral abscess with inferior endplate destruction at the level of 7th cervical, 1st and 2nd thoracal spine. The abscess pushed trachea to its contralateral position, narrowed tracheal lumen and compressed spinal canal. Histopathology examination supported the diagnosis of granulomatous inflammation. Other laboratory results show increased level of ADA, 52.1 U/L, in pleural fluid sample, and positive IGRA.

CONCLUSION: Cervical and upper thoracal spine tuberculosis can mask any other neurological pathologies especially in early onset, with debilitating effect if left untreated. As a radiologist, it is important to be able to detect the pathology with imaging modalities. We suggest to extend the examination to cervical spine level in patients with known spondylitis tuberculosis that present with neck pain.

Keywords: Cervical spine tuberculosis, spondylitis, CT, MRI, paravertebral abscess

Tuberculous Meningoencephalitis With Non-Specific Features : A Challenge To Diagnose The Most Severe Form Of Tuberculosis

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BACKGROUND : Tuberculous meningoencephalitis (TBME) is the most severe and life-threatening form of tuberculosis.TBME was found in 5,2% of extrapulmonary TB cases and 0,7% of all TB cases. Atypical TBME presentations frequently result in a delay in diagnosis, which can have a negative impact on the disease'sprognosis.

OBJECTIVE : The aim of this case report is To highlight the non-specific features of TBME as well as the importance of a thorough assessment.

METHODS : We reported 2 cases of TBME in children. Patient's medical history, laboratory dan imaging data were collected from medical records.

RESULTS : A 15 years-old boy was referred to Sardjito Hospital with fever, seizure and decrease level of consciousness. The meningeal sign was positive. His chest x-ray showed mediastinal mass with no signof pulmonary TB, confirmed also by the following chest CT. Non-enhanced head CT was performed and showed right hemispheric cerebral edema that was initially suspected as metastasis of the mediastinal mass. However, CSF Xpert MTB assay detected Mycobacterium tuberculosis.A 13 years-old girl complained fever, headache, focal seizure and extremities weakness. Head CT showed vasogenic edema of the left frontotemporoparietal lobe. Subsequent head MRI showed focal meningoencephalitis in the left frontoparietal lobe, left lentiform nucleus and bilateral hippocampus, suspected as herpes simplex encephalitis. But, HSV test showed negative result. The result of CSF studywas suggestive for Mycobacterium tuberculosis infection, with positive IGRA.

CONCLUSIONS: TBME can appear with a wide range of imaging abnormalities and should be considered with a highindex of suspicion. Because delays in recognizing and treating TBME can result in severe impairments and poor results, correlation among clinical, laboratory, and imaging data is essential.

Keywords : *Tuberculous meningoencephalitis, Mycobacterium tuberculosis, MRI, CT*

Rare Case in 16 Years Old Male with Reccurent Optic Nerve Sheath Meningioma Mimicking Infection in Kariadi General Hospital Semarang

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ABSTRACT

BACKGROUND : Optic nerve sheath meningiomas (ONSMs) are rare benign neoplasms of the meninges surrounding the optic nerve. Pediatric ONSMs are even more rare, comprising approximately 2%–4% of ONSMs. Almost a third of pediatric patients with ONSMs are diagnosed with neurofibromatosis type 2 (NF2).

OBJECTIVE : To find out pathognomonic sign of ONSMs in MRI.

METHOD : Patient with PA result ONSMs undergoing MRI to find pathognomonic sign.

RESULT : Brain MRI with contrast examination showed right bulbus oculi protopsis with fusiform shape lesion accompanied partially irregular margins with signal intensity hypointense on T1w, heterogeneous hyperintense on T2w. FLAIR, slightly restricted diffusion on DWI, no blooming artifact on GRE, post injection contrast enhancement seen heterogeneous. The lesion appears to encase the right intraorbital-intracanalicular segment of the optic nerve structure and extends intracranially to the optic chiasma. No infiltration of the right extraocular muscle was seen. On the right side of the basal cistern in the peri-chiasmatic region, the lesion is oval in shape with regular thin margins with signal intensity hypointense on T1w, hyperintense on T2w. FLAIR, non-restricted diffusion on DWI, no blooming artifact seen on GRE, post-injection contrast enhancement no visible enhancement. Measures approximately AP 1.7 x LL 2.2 x CC 1.9 cm. Vasogenic edema not seen on brain parenchyma. Intracranial pressure are normal at the moment.

CONCLUSION : ONSMs are rare benign neoplasms of the meninges surrounding the optic nerve. Understanding the different characteristics of ONSMs on MRI is essensial, because it enable prompt diagnosis, and guide development of suitable therapeutic methods.

Keyword: Optic nerve sheath meningiomas (ONSMs), Neurofibromatosis type 2 (NF2), Brain MR

Multiple Brain Abscesses in A Child With Cyanotic Congenital Heart Disease: A Life-Threatening Condition

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ABSTRACT

BACKGROUND: Brain abscess is a relatively uncommon but potentially life-threatening condition. Congenital Heart Disease is the most common predisposing factor and about 5 to 18.7% patients with congenital heart disease develop brain abscess. The main predisposing factors are chronic hypoxia resulting in polycythaemia, hyper viscosity and poor host immunity.

OBJECTIVE: To report a case of multiple brain abscesses in a child with cyanotic congenital heart disease.

METHOD: The data was collected from medical records, appropriate imaging archives, echocardiography, laboratory, microbiology and histopathology.

RESULTS: A 3-year-old boy was admitted to Sardjito Hospital with complaints of generalized tonic-clonic fits, vomiting and fever for about 6 weeks. He was diagnosed with congenital heart disease based on echocardiography that show DORV (Fallot type), TGA, moderate secundum ASD, severe infundibulum and valvular stenosis. There was no evidence of endocarditis. Initial contrast-enhanced computed tomography (CECT) scan of the brain demonstrating multiple well-defined ring-enhancing hypodense lesion in the right temporo-occipital region, measuring 3.3 × 2.5 × 4.3 cm with surrounding cerebral oedema, which narrowed the right lateral ventricles and caused midline shifting as far as 6.8 mm. Histopathology examination show suppurative inflammation. Blood culture showed growth of Gram-positive *Micrococcus luteus*. Serial CECT was performed to evaluate the lesion. The patient was managed with intravenous antibiotics, craniotomy abscess evacuation and re-craniotomy due to intracerebral haemorrhages. Patient was discarded after 2 months of hospitalization.

CONCLUSION: The analysis of our patients shows that brain abscesses could be life threatening condition in child with cyanotic congenital heart disease. It is important to use proper imaging modalities such as CT or MRI for early detection of the intracerebral lesion and to perform an early intervention to prevent fatal complication.

***Keyword**: Brain abscess, Congenital Heart Disease, Child, CT*

Value of MR Diffusion Weighted Imaging in Diagnosis for Brain Absceases : A Case Report

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ABSTRACT

BACKGROUND : Brain abscess is a severe intracranial infectious disease that has a prevalence of 0.4–0.9 per 100,000 population as well as high disability and morality rates. Predictive factors for poor outcome are a young age and the presence of multiple abscesses. Improvements in its diagnosis and treatment, along with advancements in imaging technologies (in particular, CT and MRI) have reduced the mortality rate of brain abscess from 40 to 10%.

OBEJECTIVE : This article report value of MR diffusion weighted imaging in diagnosis for Brain abscesses

METHOD : A thorough data collection was done from medical records.

RESULT : A 6-month-old boy presented to the emergency departement of Sardjito General Hospital with unconsciousness, weak crying, shallow, but irregular breathing pattern and inability to maintain oxygen saturation in room air. Brain MRI was subsequently performed on day 5 which showed multiple cystic cavities as hypointense on T1W1 and hyperintense on T2WI, with surrounding oedema. After contrast administration, they manifested as ring engancement; the capsule was intact and had a thin but even wall thickness. Diffusion-weighted imaging (DWI) indicated restricted diffusion suggestive of purulent material in the mesencephalon and right insular gyri. The blood cultures revealed a growth of Gram-negative bacilli with extended-spectrum beta-lactamase (ESBL) producing *Escherichia coli* (E. coli)

CONCLUSION : Among available imaging techniques, MRI is the most comprehensive and accurate diagnostic tool in patients with suspected brain abscess. The development of MRI technologies has brought in several imaging methods, including magnetic resonance perfusion imaging, magnetic resonance spectroscopy (MRS), and DWI. DWI with restricted signal is the most valuable method to diagnose brain abscess because it exhibits high sensitivity. During medication, periodic MRI examinations should be performed to monitor the morphological changes of the brain abscess to evaluate the therapeutic outcome.

Keywords: *Brain Abscess, Magnetic Resonance Imaging, DWI*

Brain Abscess Concomitant with Subdural Empyema – A Rare Case

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ABSTRACT

BACKGROUND : Subdural empyema refers to collection of pus in the space between the dura and arachnoid. It's rare finding and accounts for 15% to 20% of all localized intracranial infections. The disease was essentially fatal, but with current methods of diagnosis and treatment, mortality rates are approximately 10% to 20%. Brain abscess is defined as an encapsulated mass of bacteria, necrotic tissue, and leukocytes within the brain parenchyma. The incidence of brain abscess remains unclear and is suggested to range from 0.2 to 1.9 per 100,000 person-years, So the incidence of subdural empyema along with brain abscess is very rare.

OBJECTIVE : To identify specific features of subdural empyema with brain abscess, that sometimes resembles a brain tumor.

METHOD : Retrospectively exploring contrast-enhanced brain MRI and brain CT data, than comparing to clinical data and laboratory data.

RESULT : A 60-year-old man experienced a loss of consciousness and seizures with a history of extraction of the left maxillary molar which became infected. Laboratory examination, there was an increase in leukocytes reaching 24,650/microliter, with a neutrophil diff count of 90.3% and an increase in c-reactive protein (CRP) and procalcitonin level. Brain CT shows multiple intracranial cystic lesions both intraaxially and extraaxially. Contrast-enhanced brain MRI shows multiple intraaxial cystic rim enhanced lesions with surrounding vasogenic edema in the cortex subcortex of left temporo-temporobasal lobe suggesting an early capsulated phase cerebral abscess and multiple extraaxial cystic rim enhanced lesion in left frontotemporoparietal region showing a subdural empyema.

CONCLUSION : Brain abscess can coexist with untreated subdural empyema, which can occur in patients with risk factors such as infection in the maxillary region that aren't treated properly and presenting with septic condition.

Keyword : Brain abscess, Subdural empyema, Intracranial infection

Brain Abscess Formation as A Rare Complication In VP Shunt Insertion: A Case Report

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ABSTRACT

BACKGROUND : A VP shunt insertion infection is an important and distressing complication in 5–10% of patients, but brain abscess formation after a VP shunt is a rare complication that has been reported in only a few cases.

OBJECTIVE : To present the CT and MR imaging features in a patient with multiple abscesses caused by infection from a malfunction of the VP shunt.

METHOD : A 23-month-old male child with obstructive hydrocephalus on VP shunt was admitted to the hospital due to seizure and fever. The patient underwent non-enhanced head CT, surgical shunt removal, microbiological examination, and MRI evaluation.

RESULT : Head CT of the patient revealed cerebral edema, enlargement of ventricles suggesting hydrocephalus, multiple hypodense lesions with ring enhancement in both hemispheres and ventricles, and encephalomalacia. After surgical removal of catheters and abscess evacuation, pathological study of abscess capsules show chronic suppurative inflammation and microbiological finding of CSF sample indicating E.coli as causative pathogen of the abscess. MRI evaluation is consistent with previous findings, showing multicystic encephalomalacia subdural fluid collection suggesting empyema and ventriculitis.

CONCLUSION : Brain abscess formation is a rare complication of VP shunt, which must be considered in any shunted patient with the clinical feature of infection. Radiological examinations are required to demonstrate the location of the abscess and pathological changes in the brain parenchymal. Finding the causative pathogen by microbiological analysis, antimicrobial treatment based on laboratory findings, and removal of non-functioning catheters should be encouraged to manage this disease.

Keywords: Abscess, VP shunt, Head CT, MRI

Radiological Imaging of Intracranial and Spinal Tuberculosis: A Serial Case

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ABSTRACT

BACKGROUND: Tuberculosis (TB) remains an unfinished and common health problem in developing countries, especially Indonesia. While TB can spread to extrapulmonary sites, manifestations at the intracranial space and the spine are the most common form and have a devastating prognosis. Establishing the diagnosis of intracranial and spinal tuberculosis is another challenge and requires the synchronization between radiological findings, clinical conditions, and laboratory results. Fortunately, radiological examinations have a crucial role in the initial examination and is also able to support diagnostics. The availability and non-invasiveness nature of radiological examination also allow for early detection.

OBJECTIVE: This case series aims to present various radiological examination findings at the spinal and intracranial region of a clinical tuberculosis patient, from which radiologists will be able to make early detection and distinguish the differential diagnoses.

METHOD: We report a number of clinical tuberculosis patients, proven by lumbar puncture results or receiving tuberculosis medication, who then underwent radiological examinations (3T MRI and 128-slice CT-scan).

RESULT: All patients who underwent brain CT scans or MRI demonstrate basal cistern enhancement. Meanwhile, the patients who performed thoracolumbar MRI showed multilevel vertebral destruction, involvement of intervertebral disc, with destruction predominantly in the anterior side.

CONCLUSION: Tuberculosis can manifest in the spinal and intracranial regions. Radiology modalities may be preferred for initial examination because of their vast availability, non-invasive procedure, and imaging features that can help establish the diagnosis of ME TB.

Keywords : Tuberculosis, Meningitis, Spondylodiscitis

Herpes Simplex Encephalitis – Human Immunodeficiency Virus

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ABSTRACT

BACKGROUND : Viral encephalitis is the result of human exposure to the virus Central nervous system (CNS). There are two Types of encephalitis-primary and secondary. Primary encephalitis, when the virus directly invades the brain and spinal cord. Post-infection encephalitis also called secondary encephalitis occurs when the infection spreads the brain from another part of the body. Diagnosis is normal obtained based on laboratory tests, but imaging plays an important role in early detection and follow up.

OBJECTIVE : Knowing the brain abnormalities of the herpes simplex encephalitis, which can be detected through an MRI examination

METHOD : A 50 years old female, with history altered mental status, left lateral spastic lateralization grade less than 3, headache, HIV stadium 4 with HAART for 1 month, and herpes simplex infection about 6 month ago

RESULT : Advance MRI showed, lesion with partial indistinct margin in almost all white matter of the right hemisphere and left parieto-occipital lobe which appears hypointense with an isointense component on T1 FLAIR, hyperintense with an isointense component on T2WI and T2 FLAIR, some show slight contrast enhancement with leptomeningeal enhancement around it, on DWI/ADC showed partially restricted diffusion, and no blooming artefact on SWI/Phase Image

CONCLUSION : MRI plays an important role in detection herpes simplex encephalitis

***Key words**: Herpes simplex encephalitis, MRI, HIV*

Subdural Empyema as A Complication in A Child With History of Chronic Subdural Hematoma : A Case Report

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ABSTRACT

BACKGROUND : Subdural empyema (SDE) is an infection between the dura and arachnoid mater that accounts for up to 25% of intracranial infections. It can arise from sinusitis, otitis, meningitis, infected cranial procedures, dental complications or head trauma. Patients might present with symptoms such as headaches, seizures, vomiting, fever and mass effect. Radiologically, SDE can mimics other neurological pathology such as subacute and chronic subdural hematoma (SDH).

OBJECTIVE : To report a case of SDE as a complication in a child with history of SDH and to attain better knowledge of its features on CT imaging.

METHOD : A 5 months-old boy presented with worsening seizure, vomiting and fever. Head CT 2 weeks earlier showed chronic SDH in the left frontotemporoparietal region.

RESULT : A contrast-enhanced head CT showed hypodense lesion with thick wall along the left frontotemporoparietal region consistent with SDE, accompanied with adjacent cerebral abscess and linear fracture of the occipital bone. SDE typically presents as a thin low-density collection over the cerebral convexity, with enhancing membrane. Pathophysiologically, a surrounding inflammatory membrane will be formed to encapsulate the collection of pus in the presence of empyema. Rim enhancement is a key feature in helping differentiate SDE from subacute, or chronic SDH, since it is not normally seen in cases of SDH.

CONCLUSION : SDE and SDH can have many similarities on imaging. The presence of classic symptoms in patient with history of subdural hematoma should be considered as a sign of possible infection complication. Radiologist should always consider the clinical conditions of the patient and typical feature of CT imaging in the interpretation of subdural lesions. Early diagnosis and intervention is essential in patients with SDE to achieve positive outcomes.

Keywords: *Subdural Empyema, Subdural Hematoma, CT*

Multiple Brain Abscesses : A Fatal CNS-SLE Manifestation in Immunosuppressed Patient

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ABSTRACT

BACKGROUND : Central nervous system manifestation of Systemic Lupus Erythematosus (CNS-SLE) is a common complication, and clinically associated with morbidity and mortality. Childhood-onset SLE has a more aggressive disease course than in adult. The treatment of SLE patients is mainly based on the use of immunosuppressive drugs, which significantly increase the risk of infection. Superimposed infection can trigger disease exacerbation and is a leading cause of mortality.

OBJECTIVE : To report a case of multiple brain abscesses as CNS-SLE manifestation in immunosuppressed patient and to attain better knowledge of CNS-SLE, and its features on head CT imaging.

METHOD : A 14 years-old girl with history of SLE and under SLE protocol treatment during the last 2 months, admitted with fever, headache that worsened in the last 1 week, and loss of consciousness. The patient underwent head and chest CT, as part of diagnosis pathway. She died after a couple of days because of septic shock and other severe complications.

RESULT : Contrast-enhanced head CT revealed multiple brain abscesses with surrounding vasogenic perifocal edema, meningitis with ventriculomegaly, cerebral edema, and encephalomalacia. Chest CT showed multiple pulmonary cavities and nodules, pneumonia. Previous head CT showed brain atrophy, and other laboratory result showed positive ANA-IF test, low C3 and C4 complement, and sign of systemic infection from blood and tracheal aspirate culture.

CONCLUSION : Infection remains an important cause of morbidity and mortality in patients with SLE. One of the risk factor is immunosuppressive therapy. Brain abscess as one of the life-threatening CNS-SLE manifestation can be diagnosed by contrast-enhanced head CT initially. It is important for radiologists to understand the imaging features of SLE and its possible complications of therapy so that they can actively participate in patients management.

Keywords : *Brain Abscess, CNS-SLE, CT, immunosuppressive*

Tuberculous Meningitis with Additional Findings Intracranial Haemorrhage

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ABSTRACT

INTRODUCTION: Tuberculous meningitis is the most common symptom of intracranial tuberculosis, and usually refers to leptomeninges infection. Tuberculous meningitis of the brain usually involves the basal cisterna, interhemispheric fissure, sylvian fissure, and gyrus. One of the complications of TBM can cause intracranial haemorrhage which is due to secondary to or associated with TBM that has been ascribed to aneurysmal rupture following the formation of mycotic aneurysms, or to non-aneurysmal rupture as a consequence of weakening of the vessel wall by the granulomatous inflammation.

OBJECTIVES: This paper aimed to describe brain MRI findings in a foal with TBM. The first case was Mr.I, 53 years old with DOC and seizures, decreased body weight. The second case is Mrs. S, 49 years old with gradual DOC, the patient has similar symptoms with case one and also underwent therapy for Pulmonary TB. Cerebrospinal fluid analysis showed neutrophilic pleocytosis with 75% increase in mononuclear cells, suggesting TB infection.

METHOD: Conducting a literature review and medical records.

RESULTS: The first patient on MRI had isointense T1WI, hyperintense T2WI/FS, restricted DWI, non-blooming SWI, rim enhanced after contrast additions in the left caudate nucleus and left thalamus supporting the appearance of TBM with tuberculoma. Interestingly, the second patient had patchy subacute ICH in the right globus pallidus with multiple extraaxial lesions, and also leptomeningeal enhancement was seen in the basal cisterns and features of TBM, On MR Spectroscopy, there was an increase in glutamate (Glx) $\pm$ 3.84 ppm and lipids $\pm$1.44 ppm

CONCLUSION: We obtained typical results on TBM for both patients. Interestingly, the second cases depicted a complication with intracranial hemorrhage which may be due to aneurysm or infectious process of granulomatous and tuberculoma.

Keywords: *Tuberculous meningitis, intracranial haemorrhage, tuberculousis*

MRI Features of Craniopharyngioma with Infection Complications After Surgery : Pre and Post Craniotomy

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ABSTRACT

BACKGROUND : Craniopharyngiomas are benign slow-growing tumors that are located within the sellar and para sellar region of the central nervous system. This tumor is an intracranial rare tumor with the prevalence is approximately 2/100,000. The onset of symptoms is normally insidious with most patients at diagnosis having neurological (headaches, visual disturbances) and endocrine (growth retardation, delayed puberty) dysfunctions. Anatomical involvement and/or surgical lesions of posterior hypothalamic areas can result in a serious quality of life-compromising sequelae Therefore, radiological diagnostic might be crucial for establishing a diagnosis and evaluating its complication that improves overall patient treatment and outcome.

OBJECTIVE : MRI examination has a significant role in intracranial mass workup The objective of this study was to present the role of MRI in the diagnosis of Craniopharyngioma and the comparison of MRI Imaging finding pre and post-treatment

METHOD : 44-year-old female, admitted with continuous headache in the last 3 months with seizure with marked neurological deficit. She was diagnosed with craniopharyngiomas based on an MRI examination. She did craniotomy surgery. She got a complication after surgery. She did MRI examination pre and post craniotomy.

RESULT : MRI Examination pre craniotomy reveals cystic mass with nodule mural enhancement and blood lipid component inside which caused non-communicating hydrocephalus. Craniotomy was performed and based on the biopsy result, the mass was diagnosed as craniopharyngiomas. After surgery, she had prolonged and worsened symptoms. MRI reexamination perform. The result was found craniopharyngiomas residif mass, intraventricular hemorrhage in lateralis ventricle & ventricle 3, meningoencephalitis, and ventriculitis

CONCLUSION : MRI is the best examination to evaluate comparison features between pre and post-craniotomy. MRI pre craniotomy was used to assess staging of craniopharyngioma and MRI post craniotomy to evaluate the result and complication. Infection can be one of the complications after craniotomy.

Keywords : Craniopharyngiomas, MRI, Complications, Infection

Transcranial Doppler to Evaluate Meningitis in Children: A Systematic Review

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ABSTRACT

INTRODUCTION: Meningitis is a devastating disease with a high case fatality rate and leading to serious long-term complications (sequelae). Furthermore, 10–20% of the survivors are prone to permanent sequelae including brain damage, hearing loss, and learning disabilities. The early identification of deteriorating cerebral hemodynamics may create a therapeutic window in which measures to increase Cerebral Perfusion Pressure (CPP). Transcranial Doppler (TCD) can evaluate the cerebrovascular hemodynamics. It was safe, low cost, easy portability, speed of imaging, no need for sedation and above all lack of ionizing radiation that make more superior than other imagings.

OBJECTIVE: To know the role of Transcranial Doppler for evaluating the cerebrovascular hemodynamics in children with meningitis.

METHODS: We conducted an overall search of 4 databases from 25 December 2021 to 25 January 2022, accepting PRISMA guidelines to assess each study using the Critical Capability Assessment Program (CASP) from the Qualitative Research Assessment List

RESULT: We found 5 studies that met the inclusion criteria from a total of 1,482 samples. Of the five results of the study stated that transcranial doppler can be used for detect decrease pulsatility index and high blood flow velocities that indicate vasculopathy. Stenosis mostly found in middle cerebral artery and can be found in anterior cerebral arteries and other basal cerebral arteries. Absent blood flow in one or more basal arteries associated with brain tissue infarction and permanent severe neurological deficit or fatal outcome.

CONCLUSION: Children with cerebral hypoperfusion in meningitis, majority had poor outcomes like vasculopathy. This progress can be evaluated with TCD. So, TCD has crucial role in the routine monitoring that can be initially considered for hemodynamic assessment and collaborate in inferring cerebral perfusion.

Keywords: Transcranial doppler, Meningitis, Children, Brain hemodynamics, Evaluation

Ventriculitis : A Rare Complication of Central Nervous System Tuberculosis

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ABSTRACT

BACKGROUND: Ventriculitis is a rare cerebral infection that hs been variably referred to as ependymitis, intreventricular abscess, ventricular empyema and pyocephalus.(1) Backflow of CSF from the extraventricular spaces into the intraventricular space might be considered as another possible route of infection leading to ventriculitis. (2) Early diagnosis is essential for the appropriate treatment of this life-threatening condition. Neuroimaging is one of the available diagnostic tools besides laboratory investigations that play an important role in diagnosing this condition.(3)

OBJECTIVE: The objective of this study was to emphasize the role of CT in the diagnosis of ventriculitis.

RESULT : We reported a case a 18 year-old girl came with complaints of decreased consciousness since 2 days before entering the hospital slowly. The patient had fever, seizures and headache. The patient has difficulty eating and drinking since the last 2 days. History of tuberculous meningitis in 2018 and treatment to completion. Head CT scan findings demonstrate hyperdense layering material. Following administration of contrast, thin uniform enhancement of the ependymal lining of the ventricles seen.

CONCLUSION: We report of concurrent of ventriculitis and meningitis in tuberculosis patient. This case is being presented because of extreme rarity. Medical therapy is generally advocated as the initial treatment.

Keywords: Ventriculitis, CT findings

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Detecting Leukoencephalopathy in Childhood Acute Lymphoblastic Leukimia Using MR Imaging: A Systematic Review

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ABSTRACT

BACKGROUND: Acute lymphoblastic leukemia (ALL) is a malignant proliferation of lymphoid progenitor cells in the bone marrow, blood and extramedullary sites. ALL is the most common childhood malignancy. Survivors of ALL have frequently been exposed to cranial radiation, systemic and intratechal chemotherapy, which places them at risk of developing chronic leukoencephalopathy (LE). LE may present as focal weakness, seizures, headaches, and confusion. Better understanding at risk of leukoencephalopathy can lead to an improved quality of life for these cancer survivors. MRI was to investigate severity of leukoencephalopathy in childhood leukemia patients, including possible risk factors, and its association with acute neurological events.

OBJECTIVE: To know role of Magnetic Resonance Imaging (MRI) for detecting leukoencephalopathy in childhood acute lymphoblastic leukimia.

METHOD: We conducted an overall search of 4 databases from 20 December 2021 to 23 January 2022, accepting PRISMA guidelines to assess each study using the Critical Capability Assessment Program (CASP) from the Qualitative Research Assessment List

RESULT: We found 9 studies that met the inclusion criteria from a total of 1,687 samples. All studies stated that chemotherapy affecting several white matter tracts. The tracts demonstrated longitudinal changes of decreasing mean and radial diffusivity. Other abnormalities include widespread reductions in brain volume, lowering cerebral blood flow and metabolic activity, and nonspecific white matter high signal intensity in flair images. MRI indicated early neurotoxicity as evidenced by greater leukoencephalopathy.

CONCLUSION: The neurological complications of acute lymphoblastic leukemia have common presenting symptoms but varying imaging abnormalities, with white matter being affected. Leukoencephalopathy during long-term follow-up were associated with microstructural white matter integrity. MR imaging can detect of clinically consequential white matter abnormalities in childhood acute lymphoblastic leukemia survivors treated with chemotherapy and in children undergoing treatment.

Keywords: Magnetic Resonance Imaging, Acute Lymphoblastic Leukimia, Children, Neurotoxicity, Chemotherapy.

Multiple Brain Lesion: Comparison of Proven Cases of Brain Abscess vs Metastase Descriptive

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ABSTRACT

BACKGROUND : Multiple brain lesions are a broad collection of pathological processes that result in changes on brain imaging. They are a very disparate group of conditions ranging from infection (brain abscess) and metastatic. Brain abscess are difficult to differentiate from metastases with a known primary cancer. MRI sequences can help in differentiating between the two. A number of features of a brain lesion can help to narrow the differential.

OBJECTIVE : To compare multiple brain lesion of MRI brain abscess and metastase

METHODS : We present MRI features of a fifty nine-year-old patient of brain abscess confirmed by biopsy compared with of fifty-year-old patient brain metastases of lung cancer.

RESULTS : Patients with brain abscess showed distinctive clinical and MRI features. Brain abscess tend to have DWI visible area of limited diffusion, on the administration of contrast visible rim of regular contrast enhancement and meningeal elevation with extensive perifocal edema on MRI images in comparison with metastasis.

CONCLUSION : Compared with metastasis, MRI Brain Abscess can represents true restricted diffusion and half of the rim-enhancing lesions.

Keywords: brain abscess, MRI, metastase

Eccentric Target Sign in MRI of HIV Patients with Cerebral Toxoplasmosis: A Case Series

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ABSTRACT

BACKGROUND: Toxoplasmosis is one of the most common infections in immunocompromised pasien. About 30% of the world's population have antibodies to the intracellular protozoan parasite Toxoplasma gondii and about 36·7 million people are infected with HIV. As the number of HIV increased, cerebral toxoplasmosis became one of the most frequent opportunistic infections and the most common causes of focal brain lesions in this population

OBJECTIVE: To present the MRI features of three patients with cerebral toxoplasmosis due to HIV

METODE: Three HIV-infected patients aged 40, 51 and 53 years old were admitted to the hospital due to chronic head pain and seizure. These patient underwent contrast-enhanced head MRI which showed And serology examination for infectious disease.

DISCUSSION: MRI shows multiple lesions which distributed in corticomedullary junction of bilateral frontoparietalis, bilateral ganglia basalis, occipital lobe, and lobus posterior cerebellum with varying size. The lesions were characterized by eccentric target sign in post-contrast T1W, concentric target sign in T2W, and vasogenic perilesional edema in T2Wor FLAIR sequences. The patients serology test showed a significant increase in IgG serum toxoplasma.

RESULT: The typical MRI finding in patients with cerebral toxoplasmosis are multiple heterogeneously enhancing lesions in bilateral cerebral as well as cerebellar hemispheres and some of them showed “eccentric target sign “ in basal ganglia, Corticomedulary junction, thalamus and cerebellum are the most common sites with surrounding edema. These findings were also observed in our case series. Radiologist need to be very familiar with typical imaging presentation of cerebral toxoplasmosis, especially in patients with known risk factors.

Keywords: Cerebral toxoplasmosis, HIV, MRI, eccentric target sign, concentric target sign

An Unusual Cause of Rim Enhancing Lesion of The Brain – Case Report of Cerebral Aspergillosis Mimicking Tuberculoma

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ABSTRACT

BACKGROUND : Rim enhancing lesion is one of the most commonly abnormality founded in the brain. These lesion can be caused by various entities such as infection, neoplasm or demyelinating diseases. CNS tuberculosis is usually regarded as one of the differential diagnosis of rim enhancing lesion of the brain in Indonesia. Cerebral aspergillosis is especially rare and the one that mimics CNS tuberculoma is even more rare.

OBJECTIVE : The aim of our case report is to present the radiologic features of cerebral aspergillosis and to describe some discerning clues that might help us to improve our differential diagnosis.

METHOD : A 36 years-old immunocompetent female presented with chronic headache for 6 months, stuffy nose and progressive right eye visual disturbance. The patient seek medical help and was diagnosed with cerebral mass. Because of the sudden visual loss and worsening of symptoms, the patient was hospitalized for further evaluation.

RESULT : Contrast enhanced MRI was performed and multiple rim enhancing lesions with various size as well as diffuse cerebral edema were found. The radiologic feature of the MRI was favoring to infection or abscess especially CNS tuberculosis but wasn't convinc`ing enough. To prove the diagnosis, a biopsy was ordered and dicothomous branching hyphae that favoring Aspergillus sp. was discovered. Aditionally the tissue samples were further cultured and showed postive cultured of Aspergillosis fumigatus.

CONCLUSION : Cerebral aspergillosis is a very uncommon entities especially among immunocompetent patient but it remains as one of the differential diagnosis that should be considered, especially if there is paranasal involment alongside the lesions.

Meningoencephalitis Mimicking Vasculitis : A Case Report

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ABSTRACT

BACKGROUND: The prodrome of meningoencephalitis is often non-spesific, making it clinically difficult at an early stage to distinguish from other neurological syndromes. There is typical clinical presentation and imaging finding between meningoencephalitis and vasculitis.

OBJECTIVE: We reported a case of meningoencephalitis that mimicking vasculitis

METHODS: A 9-years old woman was admitted progressive left hemiparesis and loss of conciousness. There are no history of trauma, fever, tumor, radioteraphy, dental nor throat infection. LCS test have been taken and still wait for the result.

RESULTS: Multiple lesion at intraaxial supratentorial, strict lines irregular at right lobe frontalis cortex et parietalis, in T1WI isointense, T2WI hyperintense, T2FLAIR showed hyperintense with oedem. DWI: there is restricted diffusion area, on contrast showed gyral enhancement with increased rCBV, decreased rCBF, increased TTP, and prolonged MTP on intralession that appear meningoencephalitis. Imaging findings of vasculitis showing discrete or diffuse supra- and infratentorial lesions involving the deep and superficial white matter. In addition, areas of infarct and hemorrhage may be seen, the lesions enhance in 90% of cases. DSA supports the diagnosis of vasculitis when biopsy is not undertaken or yields negative results despite other clinical and laboratory evidence. Vasculitis lesions usually affect both hemispheres.

CONCLUSION: The incidence of meningoencephalitis that mimicking vasculitis was rare. Analyzing imaging feature and distinguishing between meningoencephalitis and vasculitis could be improved by analyze radiological findings on MRI.

Keywords: meningoencephalitis, vasculitis

Progressive Multifocal Leukoencephalopathy as A Rare And Fatal Neurological Manifestation in HIV Patient: A Case Report

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ABSTRACT

BACKGROUND. Progressive multifocal leukoencephalopathy (PML) is a rare and fatal neurological manifestation occuring in patients with HIV/AIDS. It is considered the manifestation of oligodendrocytes demyelination in the brain. This condition usually develops in patients with CD4 counts less than 200 cells/µL.

OBJECTIVE. To present magnetic resonance appearance of progressive multifocal leukoencephalopathy in HIV patient.

METHOD. A 21-years-old man was admitted to our hospital with tetraparesis, urinary incontinence, alvi incontinence, visual disorders and swallowing disorders. These symptoms were progressive, gradually worsen in the last 1,5 months. Physical examination found patient had spastic tetraparesis. Laboratory findings were low neutrophil, reactive HIV serology, low CD4 lymphocyte percentage (13%), low absolute CD4 counts (293 cells/µL), positive TPHA serology, positive VDRL serology, altered protein, glucose and positive pandy test in CSF. Contrast-enhanced brain MRI was performed in our hospital. The patient was managed with intravenous fluids, antiretroviral drugs, antibiotics and corticosteroids.

RESULT. Brain MRI showed non-enhancing multiple, asymmetric at periventricular and subcortical lesions in bilateral cerebral and cerebellar hemisphere. They appeared hypointensity signal in T1W, hyperintensity signal in T2W and FLAIR, slightly peripheral pathcy diffusion restriction in DWI, significantly increased choline in MR spectroscopy and slightly reduction in right lateral ventricle size.

CONCLUSION. Our case report illustrates that progressive multifocal leukoencephalopathy in HIV patient can show typical MRI appearance even with CD4 levels more than 200 cells/µL.

Keywords: Progressive multifocal leukoencephalopathy (PML), HIV, MRI

Toothache Induce Cerebral Mycotic Aneurysm In Adult: A Rare Case

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ABSTRACT

BACKGROUND: Cerebral Mycotic Aneurysm (CMA) is a rare inflammatory neurovascular lesion due to an infectious break in the wall of an artery with the localized dilatation and formation of a blind, saccular outpouching that is contiguous with the arterial lumen. The prevalence of CMA is 0,7% - 4% among all patients with cerebral aneurysm. CMA are detected in 2% - 4% of patients with Infective Endocarditis (IE). IE is considered the most common underlying causative etiology of CMA. Periodontal disease is significantly associated with IE risk in patients with pre-existing cardiovascular diseases. The clinical manifestations of CMA are diverse. Nontreatment or delayed treatment of CMA often leads to fulminant sepsis, spontaneous arterial rupture and death.

OBJECTIVE: To present spectrum imaging findings of CMA, from a patient with a typical history and pathognomonic clinical findings.

METHOD: The patient was subjected to the examination of chest x-ray, panoramic dental x-ray, echocardiography, brain MR and Digital Subtraction Angiography (DSA).

RESULT: A 48-year-old female with the chief complaint of prolonged fever for more than 7 days accompanied by Janeway lesion at her body, she had a history of chronic periodontitis and chronic gingivitis. The patient also had headache, mixed transcortical aphasia and left side weakness. On physical examination, the patient has an extra beat and murmur of heart sound which confirmed on echocardiography she had moderate to severe mitral regurgitation with undulating mass suggestive vegetation. Panoramic dental x-ray show multiple dental caries and periapical abscess, on brain MR found saccular aneurysm at right middle cerebral artery which was confirmed by DSA.

CONCLUSION: Patients with a history of poor dental hygiene, especially when accompanied by typical clinical findings of infective endocarditis and neurologic deficit, should always be considered for the possibility of CMA. Early diagnosis and intervention are expected to prevent lethal complications.

Keywords: Aneurysm, Cerebral Mycotic Aneurysm, Infective Endocarditis, Janeway lesion, Periodontal Disease, Periodontitis, Brain MR, DSA.

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Spinal Intramedullary Tuberculoma: A Rare Case Report

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BACKGROUND: Mycobacterium tuberculosis is a serious pathogen worldwide. This bacterium is found to be able to spreatd to many organs, including central nervus system (CNS). CNS tuberculosis is a rare form of extrapulmonary tuberculosis and is often the result of hematogenous spread from of primary focus, mostly the lung.(1) Brain is far more commonly affected than the spinal cord, and the most common manifestations of CNS tuberculosis are tuberculosis meningitis and intracranial tuberculoma. Spinal intramedullary tuberculoma is a rare manifestation of disseminated tuberculosis, commonly found in young people and mostly involve thoracic spinal cord. (4) Beside its clinical manifestation, radiologic examination is important in diagnosing CNS tuberculosis. This case report describes a rare case of intramedullary tuberculoma and the role of MRI in detecting its specific findings.

OBJECTIVE: The objective of this poster is to emphasize the role of MRI in the diagnosis of intramedullary tuberculomas.

CASE PRESENTATION: We reported a case of a 26 year-old man who came with weakness, pain, tingling sensation from the knees to the tips of the toes and numbness, and decreased touch sensation of both lower limbs since 4 months ago. The patient also complained of sudden involuntary movement of the legs and problems in urinating. The patient denied any trauma prior to symptoms but had a history of pulmonary TB, he claimed to had completed a 6-month tuberculosis treatment regime 1 year ago. Chest x-ray showed miliary tuberculosis. MRI of the spine showed hyperintense oval-shaped and well-circumscribed lesions at levels of thoracal vertebra 1-3 and 7 at Dixon T2WI. In the gadolinium-enhanced images, the lesions were shown to be ring-enhanced.

DISCUSSION: For spinal intramedullary tuberculosis, MRI is the optimal tool because it can accurately show location, size, and number of lesions, as well as presence of degeneration and necrosis around the lesions. The differential diagnoses include common spinal intramedullary tumors, such as astrocytic glioma, ependymocytoma, and hemangioblastoma.7 In later stage of infection, after enhanced scanning, there is rim enhancement and low signal in the central region. Later with the development of caseation, T2WI shows a typical “target sign”, representing the low signal target to the high signal rim.

CONCLUSION: We report of a rare case of spinal intramedullary tuberculomas in a patient with history of miliary pulmonary tuberculosis. MRI is helpful in detecting the lesions and determining further treatment.

Keywords: Tuberculoma intramedullary, MRI, Spinal

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Prolonged Post-Polypectomy Mucous Secretion Associated with Preoperative Radiological Findings of Paranasal Sinuses on A Rhinosinusitis Patient: A Case Report on RSUD Dr. Moewardi Surakarta

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ABSTRACT

BACKGROUND: Rhinosinusitis is characterized by a build-up of nasal secretion in rhinal and sinuses (usually maxillaris) because of the accumulation of nasal infections' byproducts. Maxillary sinus works to sustain the respiratory and immunology function of the rhinal and sinuses by supporting the production of Nitric Oxide. Prolonged infection will increase secretion that cause clinical symptoms such as headache, nasal congestion, and distorted sense of smell.

CASE REPORT: A 57-year-old male patient came in with a headache and nasal congestion. Right and left nasal polyps were found. Paranasal sinuses CT Scan showed fluid with 17 HU density in maxillary sinus and hypertrophy of bilateral medial and inferior concha. Left maxillectomy and polypectomy was done. The patient was complaining about mucous and bloody left nasal secretion up until 32 days after the surgery, a condition that, to our knowledge, has not been previously reported.

DISCUSSION: The nose consists of fossae and cavum nasi, which is divided by nasal septum as the extension of the turbine system in the nose. The turbinate is coated by mucous membrane to humidify inspired air and make it warmer. Nasal mucosa has a rich vessel and lymphatic system as a first-line defense mechanism of the respiratory tract. Runny nose experienced by the patient in this case might be caused by mucous secretion of the goblet cells and nasal glands or by the sinuses fluid excretion process. Post-maxillectomy nasal blood secretion could also be the result of micro-injury on maxillary sinus vasculature. Neovascularization in polyps formation might also increase the risk of post-polypectomy bleeding. Concha hypertrophy, septum deviation, and polyps were also found in physical examination.

CONCLUSION: Mucous and bloody secretion in this patient has not been reported in any other research, so the definitive cause of this case is still unsettled. Comprehensive imaging findings can be used to acknowledge patients' condition before surgery.

Keywords: maxilectomy; polypectomy; runny nose;ct scan; surgery

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Region of Interest (ROI) Precision in ADC Map: A Comparative Study of Brain Abscess and Glioblastoma Cases

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ABSTRACT

INTRODUCTION : ADC in MRI is sensitive to distinguish the characteristics of various lesions in the brain. Radiologists need to determine the accurate diagnosis. Infections and tumours in the brain have different lesion characteristics. Accurate and quick diagnosis provide better prognosis for therapy administration. Brain abscess is a manifestation of infection in the brain with an incidence of 3-9 patients per 1 million population. The ADC value was determined by placing ROI in identical slices. Unprecise placement of ROI may result in different values.

OBJECTIVE : The study aims to compare ROI placement in various locations of brain abscess and glioblastoma. The cases had been diagnosed through various modalities (histopathology, laboratory, and radiology).

METHOD : A total of 15 ADC maps (8 brain abscess and 7 glioblastoma) were obtained from Radiology Department of Dr. Moewardi Hospital from August 2021 to January 2022. ROI circles with a diameter of 0.49 to 0.51 cm^2 were placed on the ADC map with 4 variations (peripheral, central, whole lesion, and random placement) which were repeated 3 times. All variations of ADC values from each ROI were compared using one-way ANOVA and post hoc tests. Then, the four variations of ROI were compared to differentiate brain abscess from glioblastoma.

RESULT : Placement of ROI in the peripheral, central, whole lesion, or random placement did not have a significant difference, both in cases of brain abscess and glioblastoma ($p>0.05$). In each of the ROI variation, only peripheral ROI had a significant difference ($p=0.001$) for differentiating brain abscess from glioblastoma.

CONCLUSION : The placement of ROI on the ADC map in the peripheral area of the lesion is important for diagnosing and recommended since brain abscess and glioblastoma are often accompanied by haemorrhagic transformations and necrotic areas by still considering the placement rules (avoiding oedema and normal brain parenchymal region).

Distribution Characteristic of Maxillary Sinusitis with Anatomy Variations in RSUD Dr. Moewardi Surakarta

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ABSTRACT

BACKGROUND: Determining the anatomical variations of maxillary sinus and accompanying structures in patients with maxillary sinusitis, especially who would undergo surgery will significantly help with providing surgical orientation and preventing possible complications. The aim of this study is to determine the characteristic of patients with maxillary sinusitis accompanied by anatomical variations.

METHODS: Using retrospective cohort study, patients diagnosed by maxillary sinusitis between October until December 2021 with anatomy variations of nasal sinuses proven by Computed Tomography (CT) was admitted into this study. We exclude patients with nasal mass, maxillofacial trauma, and allergic sinusitis history. We described 48 patients based on distribution characteristic of maxillary sinusitis with anatomy variations including sex, age, location, and anatomy variations.

RESULTS: Found the prevalence is more common in women (60,5%) than in men (39,5%) with average age 48 years old. The most common location of maxillary sinusitis is bilateral (53%). Septal deviation found as the most common anatomy variation (91%) than agger cell (10%), onodi cell (4,1%), khun cell (4,1%), haller cell (8,3%), and choncae bullosa (20%).

CONCLUSION: The prevalence of women with maxillary sinus is greater than men with anatomical variations of septal deviation was the most frequent findings.

Keywords: Maxillary sinusitis, Anatomy variations

Acute Transverse Myelitis in Pregnant Woman with COVID-19 Infection: A Case Report

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ABSTRACT

BACKGROUND : Transverse myelitis is an inflammatory spinal cord syndrome, which develops sensory, motor, or autonomic dysfunction bilaterally. There is growing evidence to support the potential for central nervous system (CNS) involvement in the context of acute and post-COVID-19 infection.

OBJECTIVE : To report a pregnant woman with COVID-19 infection in Bali who developed acute transverse myelitis.

CASES REPORT : A 30 y.o pregnant woman admitted to hospital with progressive bilateral lower limb weakness and urinary retention since the day before. During admission patient also developed coughing and difficulty to breath. A nasopharyngeal swab for COVID-19 was positive. No antivirals or immune-modulatory drugs were given apart from the methylprednisolone.

RESULT : Preliminary blood tests revealed a normal C-reactive protein, lymphopaenia, elevated ESR and D-dimer. MRI whole spine without contrast was perfomed show an intradural intramedulla long segment lession affected anterior-posterior segment bilaterally in spinal cord at the level C2-Th1, L1-2 with expansion spinal cord at level C2-6 and intradural intramedulla short segment lession, wedge shape at anterior-posterior segment dextra Th3-4 that have high signal in T2WI, this lession suggested to myelopathy (transverse myelitis) dd/ spinal spinal (Astrocytoma dd/ Ependymoma). Cerebrospinal fluid collected showed elevated protein count and low glucose. Aquaporin 4 IgG and ANA test/ANA profile were negative.

CONCLUSION : We have presented a suspected case of ATM in the context of recent COVID-19 infection, in this case we role out the possibility of auto immune disease because the ANA test/ ANA profile and Aquaporin 4 IgG were negative. But there is still the possibility of spinal tumor because after corticosteroid treatment the symptoms of the patient didn't get better. MRI whole spine with contrast will play a major role to determine caused of patient's bilateral lower limb weakness so she will get a better management.

Keywords : acute transverse myelitis , pregnant woman, COVID-19

The Correlation of Temporal Bone CT with Histopathological Findings in Evaluation of Chronic Inflammatory Diseases of The Middle Ear

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BACKGROUND : Computed tomography (CT) of mastoid air cells in temporal bone is a preferred modality to investigate mastoiditis as a complication of chronic inflammatory diseases of the middle ear with cholesteatoma. Cholesteatoma was diagnosed by identifying a soft tissue mass in the middle ear associated with bone erosion/destruction and can be verified by histopathological examination.

OBJECTIVE : The aim of this study is to evaluate the presence of bone destruction in CT findings and its correlation with histopathologic features in patients with mastoiditis.

METHODS : Patients with suspected mastoiditis were retrospectively analyzed and undergone temporal bone CT examination between January 2019 – December 2021. All cholesteatoma specimens were collected intra-operatively and preserved for histopathological examination. Associations were assessed by the chi-square test.

RESULTS : Seventeen patients were included in the study. Nine (52.9%) cases were male and 8 (47.1%) cases were female with age distribution ranges from 9 to 55 years. Ear discharge was the main clinical presentation (94.1%). CT findings showed destruction in all patients which classified into mild (41.2%), moderate (47.1%) and severe (11.8%). Histopathological examination revealed 8 (47.1%) cholesteatomas, 4 (23.5%) cholesteatomas with granulomas, and 5 (29.4%) non-cholesteatomas which consist of 4 granulomas and 1 epidermoid cyst. Leukocyte count ranged from 2,300 to 29,000 and was found elevated in 3 patients. There was no significant correlation between degree of bone destruction with histopathological findings ($p = 0.919$).

CONCLUSION : Mastoiditis may be accompanied by bone erosion/destruction in scutum, auditory ossicles, tegmen tympani, bony labyrinth, facial canal and external ear canal. In this study, soft tissue masses in the middle ear is differentiated into cholesteatoma and non-cholesteatoma. Non-cholestetomas were found in the form of cholesterol granuloma, granuloma and epidermoid cyst. CT scan is indicated to evaluate the extension and the complications of cholesteatoma and mastoiditis.

Pictorial Review: Corelation of Scoring MRI Feature of Tuberculous Spondylitis and Surgical Laminectomy in Dr Moewardi General Hospital

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BACKGROUND : Tuberculous spondylitis was often found late due to its insidious nature and taking years to develop, but now prompt diagnosis could be made earlier due to advanced technology such as MRI. This modality could give a detailed spine evaluation and the outcome of surgical treatment with adequate anti-tuberculous regimen were favorable.

OBJECTIVE : This paper aimed to highlight the MRI Finding and its Scoring using Sedineni et al (2019) criteria, and the correlation with its Surgical and Pathological output.

METHOD : Five cases of Tuberculous Spondylitis managed by Surgical Laminectomy continued by pathological examination were included in this pictorial review. MRI finding were being assessed with scoring using Sedineni et al criteria (2019). The imaging features supporting the diagnosis of Spondylitis were shown and analyzed with its laminectomy outcome.

RESULT : Patients consisted of three male and two female with youngest age of 22 and the oldest of 65 years old. All patients showed lumbar involvement with two multiple thoracolumbar regions. Only one had active pulmonary TB while the rest had different reasoning or history of index case encounter. Of all criteria presented by Sedineni, vertebral collapse and hypointense T2WI debris were found in all patients. One patient had special finding of secondary bacterial infection and its MRI finding were atypical. Sedineni scoring (2019) had cut off value of 6 for Spinal TB and all patients scored >6 highly suggestive of Tuberculous spondylitis, proven by following Laminectomy and pathological outcome.

CONCLUSION : All five patient had laminectomy procedure executed and proven with Spinal TB. Their MRI finding analyzed by Sedineni scoring were suggesting Tuberculous Spondylitis and it correlated strongly with the surgical outcome and pathological result.

Keywords: Spondylitis, Tuberculous, MRI

Spontaneous Cerebrospinal Rhinorrhea Arise from Patent Sternberg Canal – A Rare Case

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ABSTRACT

BACKGROUND: Cerebrospinal fluids (CSF) rhinorrhea suggests the existence of leakage between intracranial CSF spaces and the nasal cavity. CSF leakage is a rare case that has been reported only 193 case in 21 years. CSF rhinorrhea is mostly caused by trauma, but can also be caused by non-traumatic etiology with a 3-4% incidence, including skull base congenital defects such as patent Sternberg canal.

OBJECTIVE: The aim of this case report is to increase knowledge about the imaging of patent sternberg canal that causes CSF rhinorrhae using CT Scan and MRI, so the clinician can do the right treatment.

METHOD: Conducting a literature review and medical records.

CASE PRESENTATION: A 38-year-old woman presented to the hospital complaining of a watery clear liquid that has been draining from her right nasal for the past two months. The liquid has no odor and does not blend with blood. It continues to drain regardless of the patient's position but becomes more noticeable when the patient bends forward or awakens from a nap. There is no history of trauma or raised intracranial pressure. The CT scan shows a lesion on the lateral of the right sphenoid sinus, and the MRI shows right temporobasal lobe herniation.

RESULT: A CSF rhinorrhoea occurs when there is a fistula between the dura and the skull base, which cause discharge of CSF from the nose and potentially cause an ascending infection which could produce meningitis. A congenital bony defect in the lateral wall of sphenoid sinus called Sternberg's canal could be the origin of these lesions as non-trauma etiology and it can be diagnose by CT scan and MRI.

CONCLUSION: CT Scan and MRI are effective methods of distinguishing between a traumatic or neoplastic lesion and a spontaneous CSF rhinorrhea, and can assist clinicians in choosing the best treatment for their patients.

Keywords: *CSF rihinorrhea, Imaging, Patent Sternberg Canal*

Cerebral Congenital Toxoplasmosis – A Case Series

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ABSTRACT

BACKGROUND: Congenital toxoplasmosis is caused by transplacental contamination from maternal primary infection. It can lead miscarriage, neurological and visual abnormalities, or be asymptomatic at birth, and showed late clinical manifestations. Brain is one of the most frequently organ in congenital toxoplasmosis, involvement of the brain in congenital toxoplasmosis may range from mild to severe.

OBJECTIVE: This case series aims to present a radiological picture of the brain manifestations of congenital cerebral toxoplasmosis with different clinical manifestations.

METHOD: A radiological evaluation of 4 cases of suspected cerebral congenital toxoplasmosis was conducted within a period of 4 months.

CASES: We have 4 cases suspected with congenital toxoplasmosis from primary infected mothers, that confirmed by the serologist test. 3 patients came with seizure, while 1 patient came without any symptoms, but the antenatal ultrasound examination showed ventriculomegaly. From the CT scan image, we can show that all the patients had brain calcification with enlargement of cerebral ventricle.

RESULT: From our cases imaging showed brain calcification as the most common finding in congenital cerebral toxoplasmosis, accompanied with cerebral and cerebellar atrophy, ventriculomegaly or hydrocephalus. The number of brain abnormality not always significant with clinical symptoms in early state.

CONCLUSION: Imaging plays a very important role in identifying the cerebral congenital abnormalities caused by toxoplasma infection. It is very helpful since some of the case does not show any sign in early state.

Keywords: *Brain Calcification, Cerebral Congenital Toxoplasmosis, Ventriculomegaly*

Central Nervous System Tuberculosis in Patients with HIV : An Imaging Focused Review

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ABSTRACT

BACKGROUND : Patients with HIV and active tuberculosis have an increased risk of extra pulmonary tuberculosis, particularly in the central nervous system (CNS) could be presented as meningitis, tuberculoma, tuberculous brain abscess. Brain tuberculoma are common found in endemic area and diagnosed using MR Imaging in patients with tuberculous meningitis, given that if meningitis occurs is indeed complication of brain tuberculoma.

OBJECTIVE : We describe MR Imaging finding of brain tuberculoma in patients with HIV.

METHOD : This case series study was performed at a tertiary hospital. We included four HIV-infected cases of tuberculoma. We focused on role of MR Imaging in diagnosing brain tuberculoma in HIV-infected.

RESULT : The first case was a 36-year-old female with a three-month history of headache and seizure. Brain MRI showed tendency to tuberculoma and meningitis depiction. The second case, a 33-year-old-female presented with history of headache, the brain MRI showed tuberculoma in right parietal lobe and left temporal lobe. The third case of a 38-year-old male patient presented with loss of consciousness, left-sided hemiparesis and positive meningeal sign, the MRI demonstrated tuberculoma in the left parietal lobe and right cerebellum as well as leptomeningeal tuberculoma. The fourth case, a 24 -year-old male presented with loss of consciousness, 2-month history of headache with left sided hemiparesis. Brain MRI showed tuberculoma in the left cerebellum, left and right temporal lobe and right occipital lobe. MR Imaging of tuberculoma shows low or high density, round or lobulated, single or multiple lesions with irregular wall and homogenous or ring enhancement after contrast.

CONCLUSION : The MRI criteria for diagnosis of brain tuberculoma apply to HIV-infected.

A Descriptive Study : Mladina's Classification In Rhinosinusitis Patients

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ABSTRACT

BACKGROUND : Nasal septal deviation (NSD) is a predisposition factor in the occurrence of rhinosinusitis. A long term obstruction in the ostium sinus will interfere the airflow causing rhinosinusitis. According to Mladina's classification NSD is divided into 6 types, and it could be accurately identified on MSCT scans.

OBJECTIVE : The aim of this study is to observe the NSD grading in rhinosinusitis patients using Mladina's classification.

METHOD : This is a descriptive study using patients who had MSCT examination of the nose and paranasal sinuses as part of their diagnostic or preoperative work up, between October until December 2021. There were 150 patients who undergo MSCT examination. There were exclusion criteria, rhinosinusitis patients with a history of atrophy and allergies, patients with nasal masses and maxillofacial trauma. Meanwhile, the inclusion criteria is patients with MSCT examination diagnosed with rhinosinusitis and nasal septal deviation. 30 cases met inclusion criteria and were analysed for Mladina's classification grading. The results were expressed in percentage.

RESULTS : A total of 30 patients showed that Mladina's classified distributed as type 1 (16.7%), type 2 (16.7%), type 3 (46.7%), type 4 (13.3%), type 5 (3.3%), and type 6 (3.3%).

CONCLUSION : Radiologically, NSD according to the Mladinas classification can be accurately and easily recognized on MSCT Scan. The most common type found was type 3, which was 46.7%, followed by type 2 and 16.7%.

Keyword(s): Septal deviation, Mladina's Classification, Rhinosinusitis


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